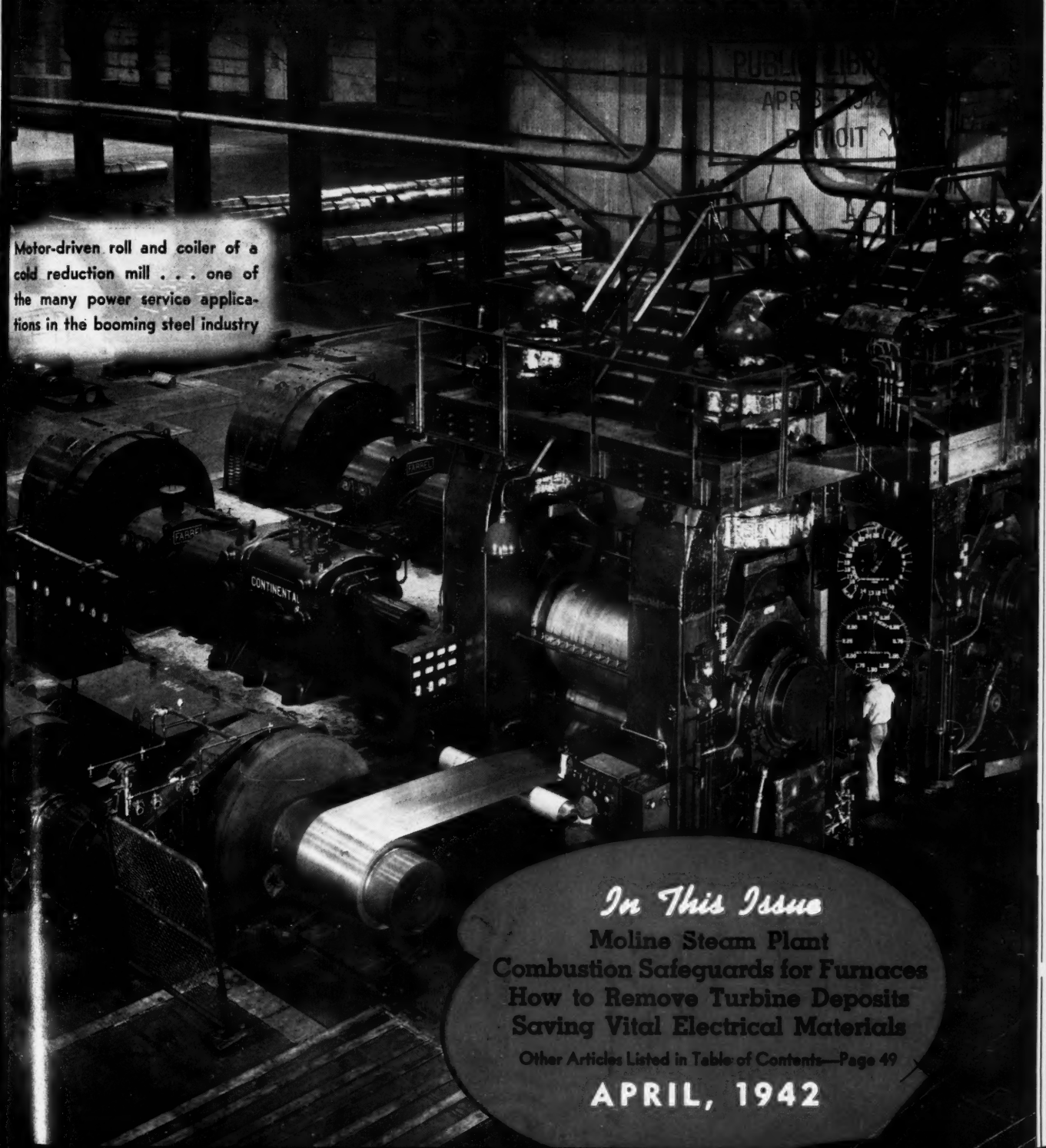
POWER PLANT ENGINEERING

THE PLANT ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY



Motor-driven roll and coiler of a cold reduction mill . . . one of the many power service applications in the booming steel industry

In This Issue

Moline Steam Plant
Combustion Safeguards for Furnaces
How to Remove Turbine Deposits
Saving Vital Electrical Materials

Other Articles Listed in Table of Contents—Page 49

APRIL, 1942

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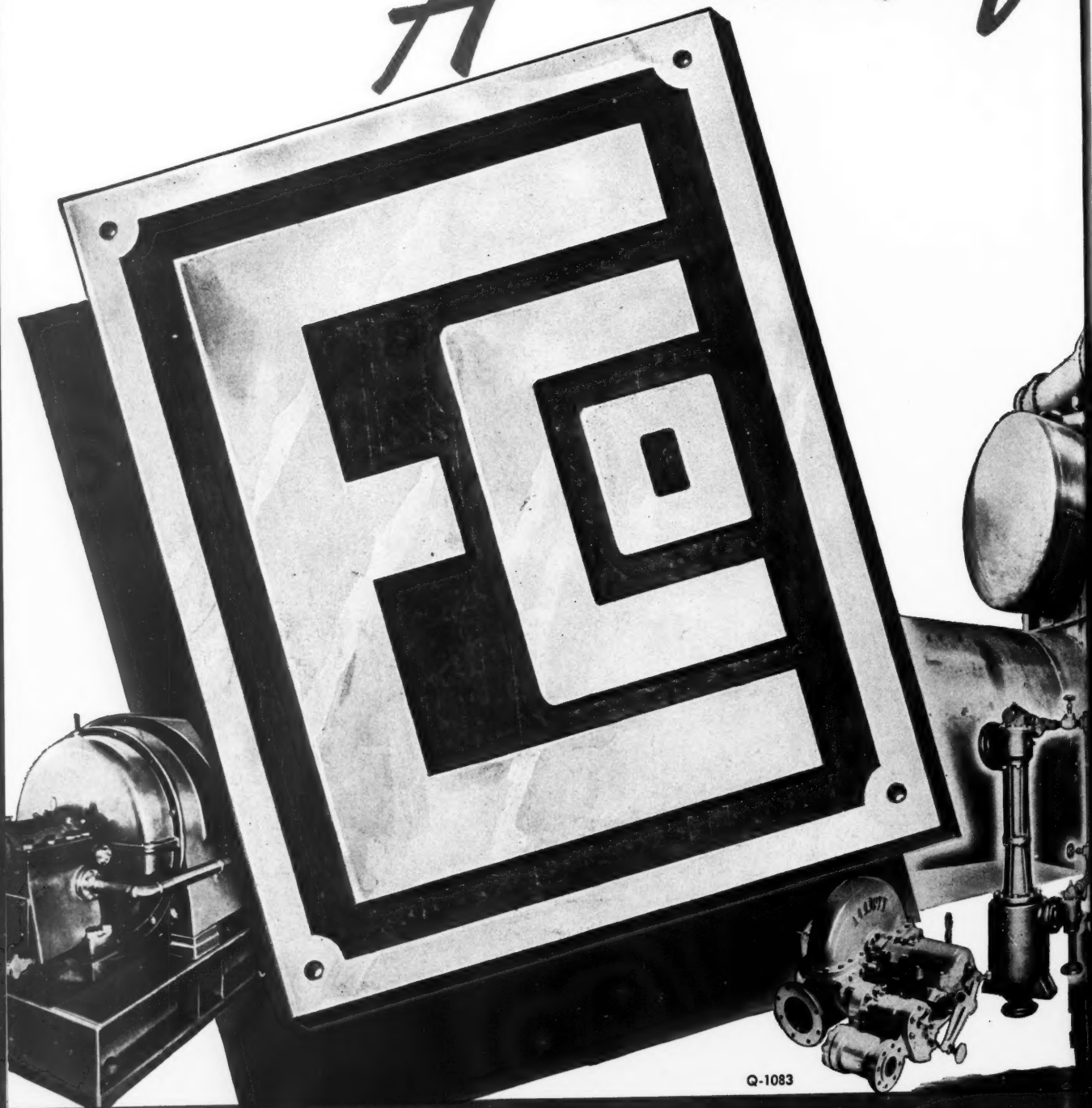


Q-1083

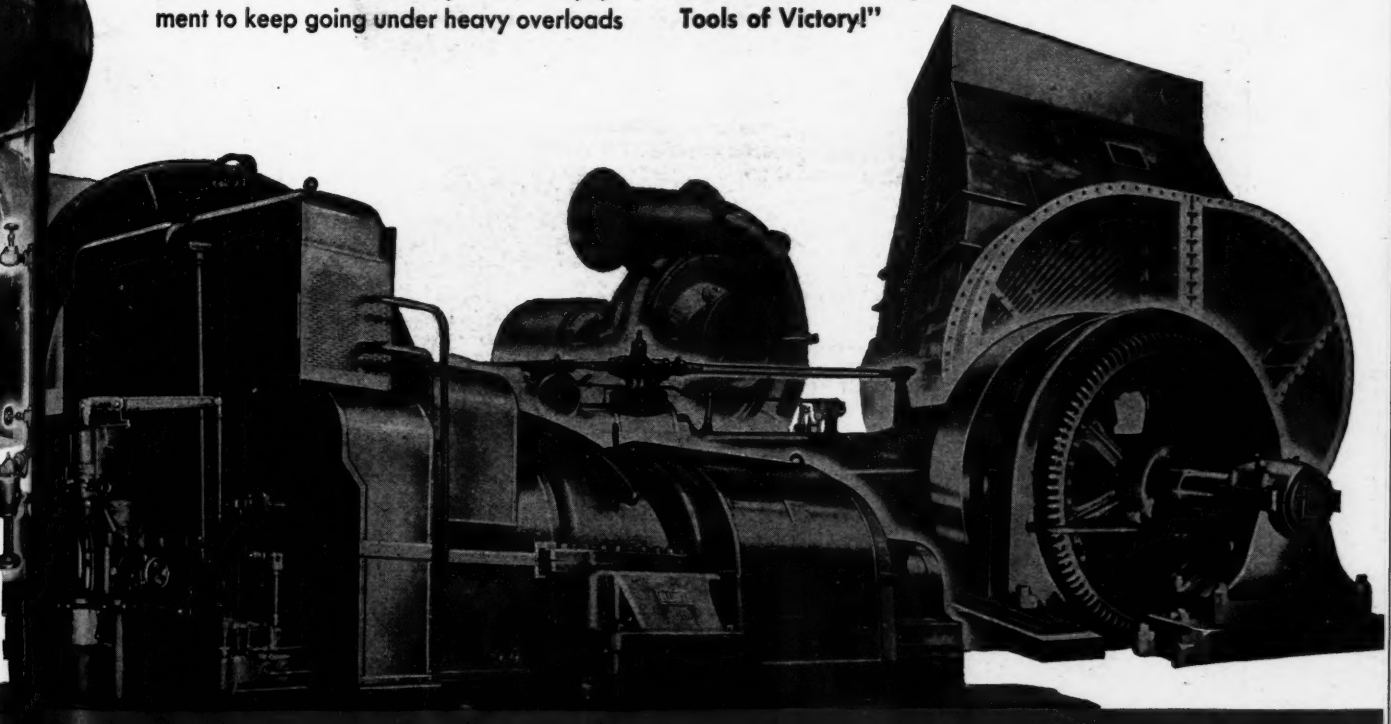
ELLIOTT

AMERICAN INDUSTRY *at its best!*

This is a day of symbols, with the "V" for VICTORY dominant. And the power behind the Victory symbol is supplied by the symbols of American Industry . . . such as the "E" monogram of ELLIOTT COMPANY.

It is now certain that the winning of World War II depends in the final analysis, upon the productive ability of American Industry. Elliott Company as a front line element in the Army of Production, is proud to place its mark upon equipment serving on every industrial battle-front, often in positions where the ability of the equipment to keep going under heavy overloads and the stress of extreme conditions, is vital to the continuance of essential production. This monogram also marks certain equipment even now in service with our armed forces—on land and sea and even beneath the sea.

This signature upon a unit of power equipment says —"Here is a turbine . . . motor . . . condenser . . . ejector . . . blower . . . which will perform its appointed task with all the certainty inbuilt by skilled management, experienced engineering, careful workmanship. Here is one of the Tools of Victory!"



COMPANY

JEANNETTE, PA. • RIDGWAY, PA.
SPRINGFIELD, OHIO
District Offices in Principal Cities

TURBINE-GENERATORS • MECHANICAL DRIVE TURBINES
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TURBO-CHARGERS • DESUPERHEATERS • STRAINERS
SEPARATORS • GREASE EXTRACTORS
NON-RETURN VALVES • LAGONDA-LIBERTY TUBE CLEANERS

12 Actual Experiences

A FAILURE made this.
A SUCCESS!
TO HALVE THE STEAM COSTS!
BECAUSE WE WERE CONTRARY... THE CUSTOMER NOW SAVES...
$10,000.00 Every year!
they called us in again!
BOILER PLANT THAT COST 25,000.00 LESS
Reduces Operating Expense Three Ways!
We Didn't
...WE GOT
But Never Using-
100 hp of Extra Steam Capacity
Paid off.....in 3 years
LESS EXPENSIVE STOKERS
...for the right STEAM GENERATING EQUIPMENT
COMBUSTION ENGINEERING

Reproductions of the twelve case histories as they previously appeared among these pages.

Reprints of the original advertisements are available. Use the numbers on the right hand page to request copies of any or all of them.

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

PROVE 1 VITAL POINT

for users of

STEAM GENERATING EQUIPMENT

The Twelve Experiences

These twelve case histories prove how C-E does much more for its customers than merely build steam generating equipment. In each example cited, C-E engineers perceived a better way to do the job . . . *they suggested a more expensive installation when it meant greater long-term economy . . . they recommended the less expensive solution when study revealed its adequacy . . . they urged alternative equipment when it pointed to the better installation* . . . and in several cases these recommendations placed a valued contract in jeopardy in order to maintain a principle of service that's dedicated primarily to the best solution of the customer's needs.

1. ***Chemical*** company accepts C-E's counter recommendation on equipment. Result—lower initial cost, higher efficiency and reduced ash-handling expense.

2. ***Mining*** company agrees to change of stoker specification after examining results of fuel tests. Result—7 years of high availability, low maintenance.

3. ***Paper*** mill induced to adopt a different type of installation that utilizes cheapest available coal. Result—operating costs 50% less.

4. ***Transportation*** system shown how to avoid the contemplated scrapping of two old boilers. Result—total cost of installation is cut in half.

5. ***Brewery*** influenced by insistent recommendation to change type of stoker. Result—an annual saving of $10,000 in fuel and maintenance.

6. ***Flour*** mill returns to C-E equipment recommendation after trying alternate method. Result—increased steam needs are satisfied; rising maintenance halted.

7. ***Coal*** company converted by fuel tests to a different method of firing. Result—more economical operation through use of lowest grade fuels.

8. ***Hospital*** learns how to save its existing boilers. Result—$25,000 lower cost plus savings of fuel, maintenance and operating expense.

9. ***Textile*** mill follows recommended purchase of steam capacity in excess of need. Result—material fuel saving and lower maintenance.

10. ***Public*** works shown how additional steam can be obtained despite limitations of existing space. Result—25% greater steam capacity.

11. ***Plastics*** plant is persuaded that objectives can be accomplished with less expensive stoker. Result—installation paid off in 3 years.

12. ***Oil*** equipment manufacturer agrees to scrap existing stokers in "working order" and spends $13,000 more. Result—saves $9,000 a year in fuel.

The One Point

C-E has the experience and engineering competence to arrive at the one optimum solution to meet the particular combination of steam demand, fuel supply and other conditions existing for any job. Then, because C-E offers a complete line of steam generating equipment, it has the unprejudiced point of view toward alternative practices that eliminates the source of bias. Moreover, C-E has a reputation for long-run service satisfaction which must be protected, and every C-E proposal for steam generating equipment, whether it be large or small, simple or complex, must meet this standard.

(See note on left page regarding reprints of these case histories)

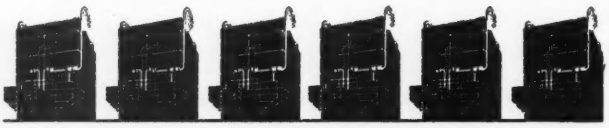
A-245

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

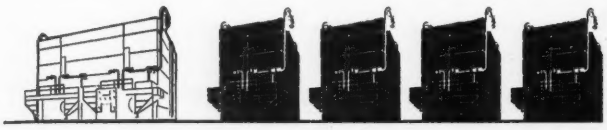
ENGINEERING

Published monthly by the Technical Publishing Co., at 53 West Jackson Blvd., Chicago, Ill., U. S. A. Subscription price, $2.00 a year. Single copies current issue, 25c. Entered as second class matter September 8, 1932, at the Post Office, Chicago, Ill., under act of March 3, 1879. Vol. XLVI, No. 4.

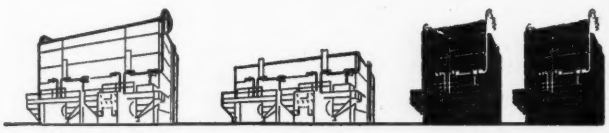
ONE boiler pinch-hits for 6 without



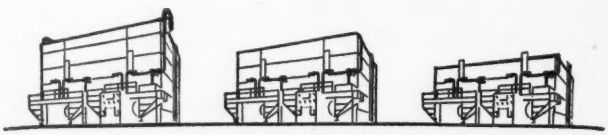
FALL 1939 A locomotive plant had coasted along for many years with six old boilers. Then war was declared and business boomed! Existing capacity proved inadequate for anticipated steam demands. A boiler replacement program was started immediately.



JULY 1940 Two old boilers scrapped and replaced by one new boiler designed for normal steam output of 25,000 lbs. per hour, about 200% rating. Hall System of Boiler Water Conditioning was employed.

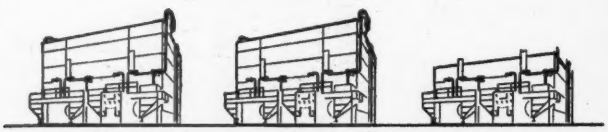


FALL 1940 New boiler No. 2 under construction — steam demands rising. Then a plant addition was started, for large-scale war production. The last two old units also had to go!



DECEMBER 1940—JANUARY 1941 New boiler No. 1 carrying entire plant load—at all-time peak due to increasing plant production and severe winter weather. Daily steam flow charts showed uniform output of 38,000 to 40,000 lbs. per hour for 16 hours. For the remaining 8-hour peak period, the pen went off the chart—production estimated in *excess* of 45,000 lbs. per hour—about *400%* rating!

Despite these critical conditions, *continuous operation was safely maintained.* No scale, carryover, tube burn-outs or outages occurred, which would have meant serious delays in production of vital equipment and possible strangulation by freezing water lines in the extremely cold weather.



FEBRUARY 1941 Second new boiler completed, relieving heavy overload on new boiler No. 1. Soon after, new boiler No. 3 entered service. By careful application of Hall System methods, plant operators had replaced six old boilers with three new ones, met *all* steam demands, and are *now* producing at an all-time high rate!

6 at 400% rating for 2 months

ut a tube loss! ... thanks to

Hall System

THE story on the opposite page is convincing evidence that *reliable* water conditioning is a prerequisite for continuous boiler operation at maximum capacity. And every power plant engineer is facing *that* prospect—even *you*.

Because water *won't* wait, *don't* wait for your water to tell you. Before you start racing your boilers you've got to be reasonably certain that conditions—on the water side—are reliably *right*.

What better way is there to be certain than to employ the system of *proven performance* (see facing page), developed by the pioneering leaders in scientific boiler water conditioning, and practiced by the leading power plants—on land and sea—not only in this country but all over the world?

That system is the Hall System of Boiler Water Conditioning.

There is no substitute for reliability—so play safe—and *stay* safe—with Hall System. Write or wire today!

HALL LABORATORIES, INC. · 300 ROSS STREET · PITTSBURGH, PA.

HALL SERVICE IN A NUTSHELL

At your immediate disposal are placed the technical knowledge and facilities of the pioneering leaders in scientific boiler water conditioning. In addition, with your full cooperation, Hall Service:

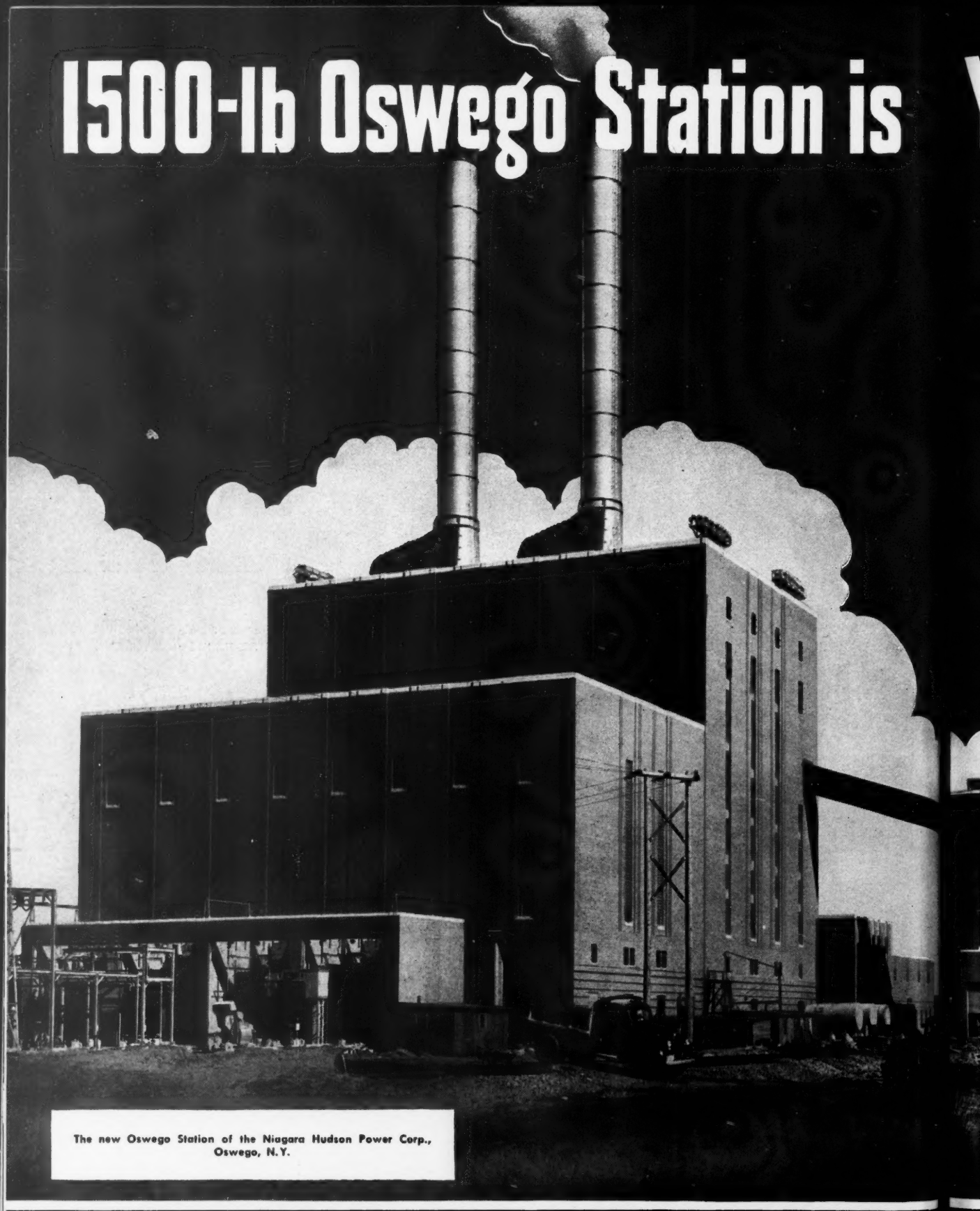
1. **Minimizes boiler outages caused by water.**
2. **Helps maintain highest efficiency.**
3. **Establishes non-embrittling water.**
4. **Minimizes carryover.**
5. **Prevents corrosion in boilers and associated equipment.**
6. **Prevents deposition in water lines and cooling systems.**

In trouble—
the "best bet" for correction.

Out of trouble—
the "best yet" for protection.

HALL SYSTEM
of Boiler Water Conditioning

1500-lb Oswego Station is



The new Oswego Station of the Niagara Hudson Power Corp., Oswego, N.Y.

YARWAY

Yarway Unit Tandem Equipped

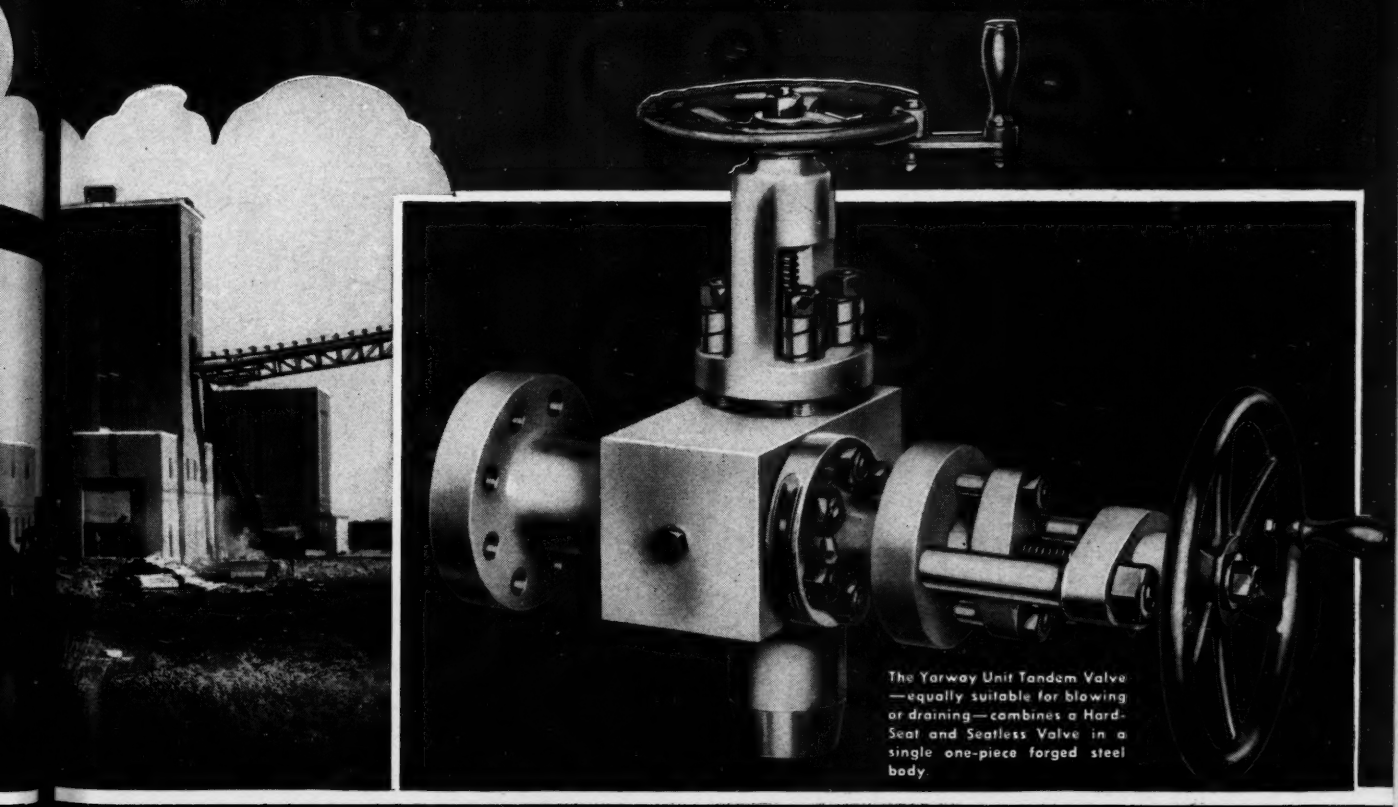
ANOTHER of the many important high-pressure utility stations to select Yarway Unit Tandem Blow-Off Valves for the most difficult of all valve services—the 1500-lb pressure Oswego Station of the Niagara Hudson Power Corp. This installation brings the number of Yarway equipped plants designed for 900 lb pressure and over to ninety-seven.

The reason for Yarway's outstanding preference is found in such records as —"*Still tight after 3000 blows at more than 1300 lbs pressure without replacement of a single part or repairs of any nature.*"

Good boiler engineering demands equally sound engineering in the accessories that become part of it. It is not only *protection for your investment, but cheap insurance against trouble and expense.*

Write for Catalog No. 430 for pressures from 400 lbs to 2500 lbs. Catalog 421 for lower pressures.

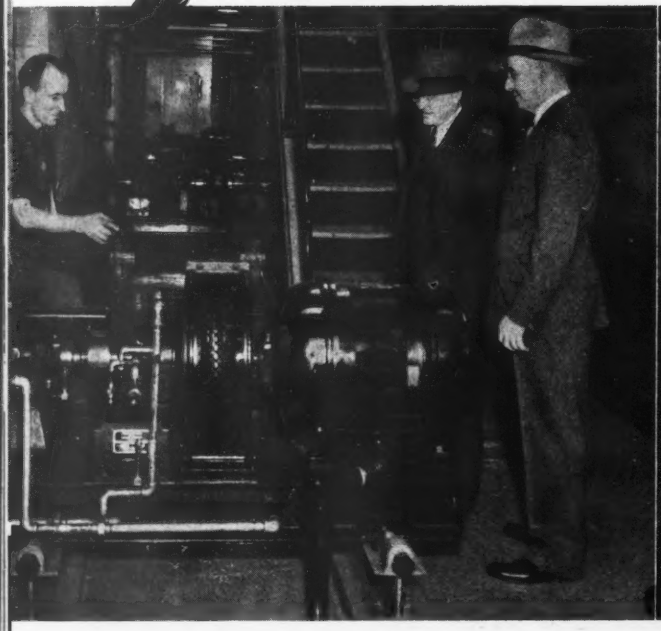
YARNALL-WARING COMPANY
114 Mermaid Ave. Philadelphia

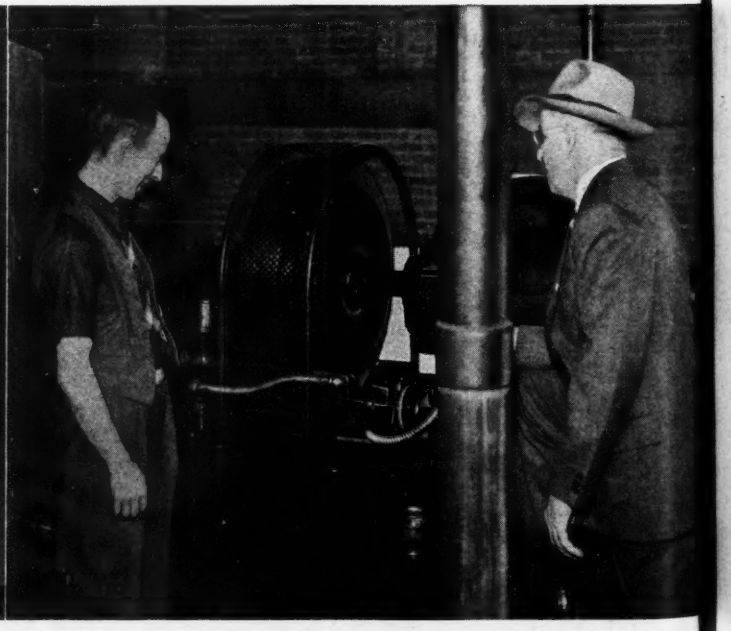


The Yarway Unit Tandem Valve —equally suitable for blowing or draining—combines a Hard-Seat and Seatless Valve in a single one-piece forged steel body.

BLOW-OFF VALVES

"Our early experience proved Fluid Drive!

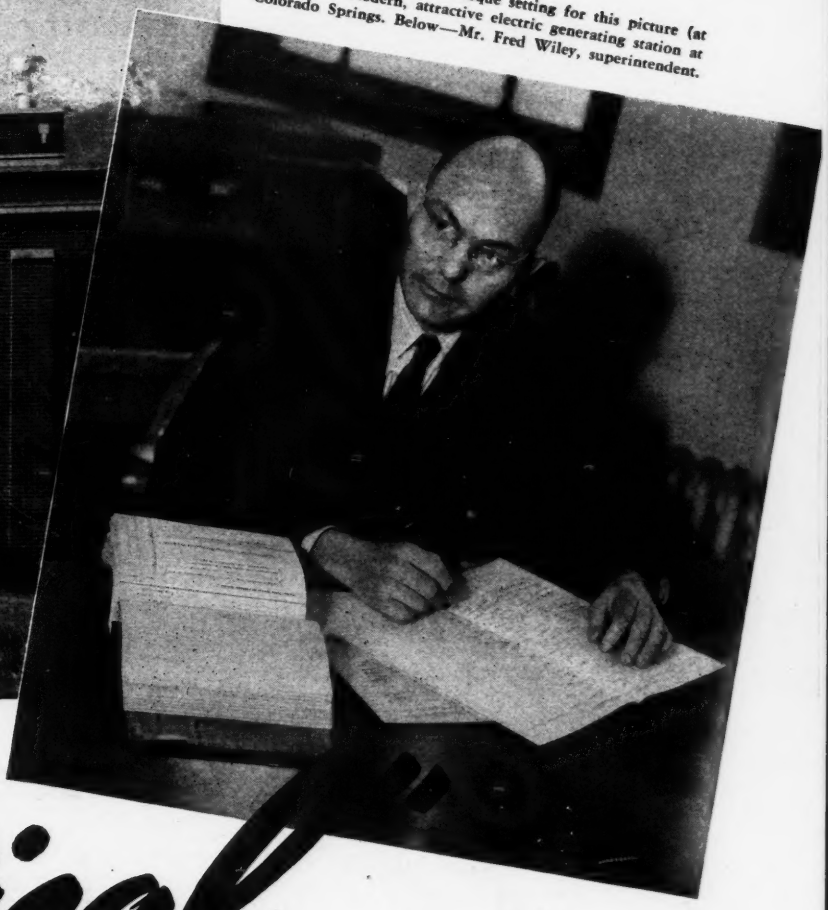




Mr. Bill Whelan, chief engineer (shown at left) and Mr. Fred Wiley, superintendent (center) take the interviewer (right) on a tour of the Colorado Springs power plant. In foreground is the first belt American Blower Fluid Drive installed. The two most recently installed Fluid Drives are shown in background.

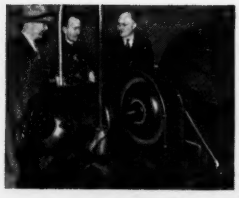
Mr. Whelan, who, like Mr. Wiley, is in a position to know, is well satisfied with the performance of this American Blower Fluid Drive, installed with an American Blower Induced Draft Fan. "The fact that we can use the simple, rugged type of motor is one of the things we like about Fluid Drive," Mr. Whelan (left) tells the interviewer.

Pike's Peak forms a picturesque setting for this picture (at left) of the modern, attractive electric generating station at Colorado Springs. Below—Mr. Fred Wiley, superintendent.



e Practical

SAYS F. H. WILEY, SUPERINTENDENT



"Our plant is now 100% Fluid Drive (Hydraulic Coupling) equipped," says F. H. Wiley, power plant superintendent of Colorado Springs, Colorado. "This expresses our opinion of them better than any other statement we could make. Since our purchase of the first two in 1932, we have replaced our three older fan drives with American Blower Fluid Drives, and now have on order two more for our latest boiler addition. We are proud of having had a part in pioneering Fluid Drives for power plant fan drive in this country. We know, by actual experience, that Fluid Drive improves overall plant efficiency."

We of American Blower are proud, too, that we have been privileged to supply not only Fluid Drives, but Forced and Induced Draft Fans for the modern electric generating station at Colorado Springs. In other fine power plants, too, serving communities large and small throughout the land, you'll find these time-proved products giving dependable service, year in and year out. If you have any problem involving Fluid Drive, Mechanical Draft or Dust Precipitator equipment, phone or write the nearest American Blower branch office today.

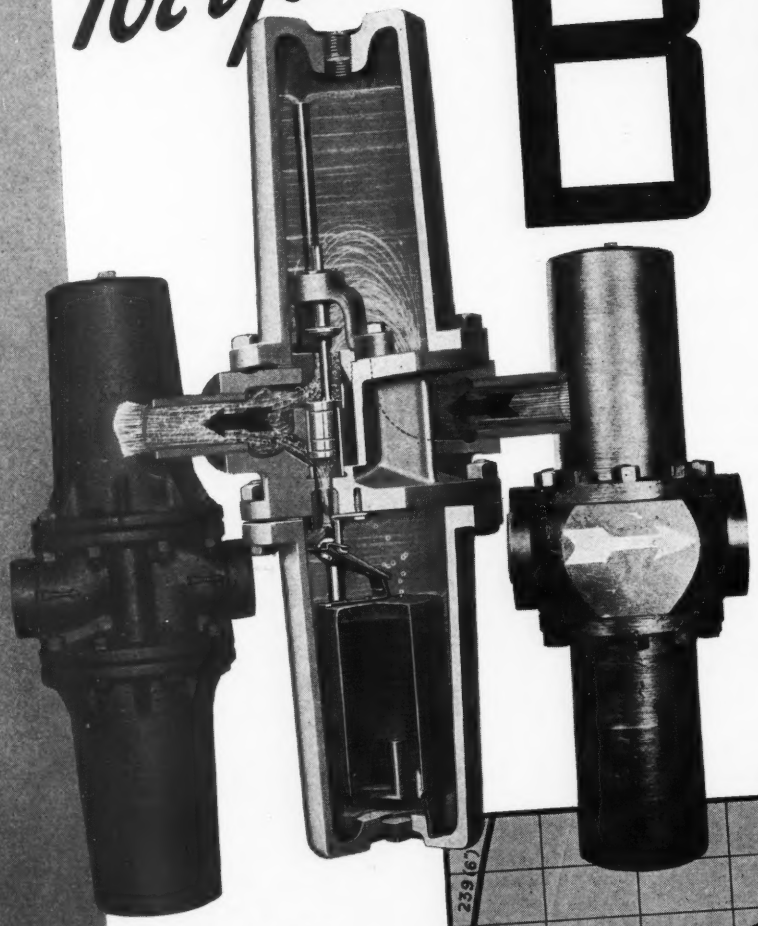
AMERICAN BLOWER

HYDRAULIC COUPLING DIVISION, DETROIT, MICHIGAN

DIVISION OF AMERICAN RADIATOR AND STANDARD SANITARY CORP.

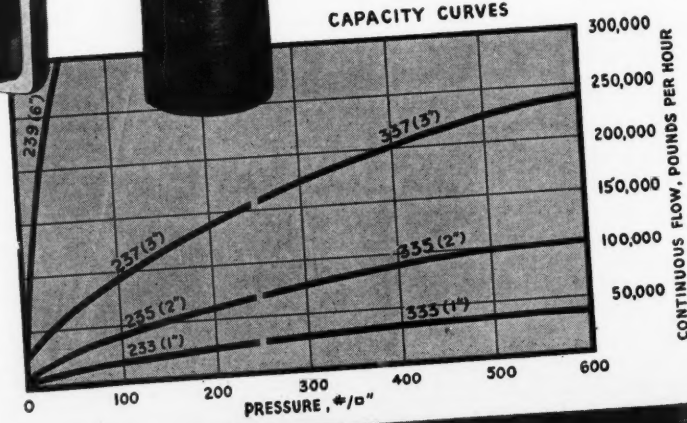
ARMSTRONG

For Your BIG



A Complete Line

● ARMSTRONG COMPOUND TRAPS are built for 1", 2", 3" and 6" pipe connections. No. 233, 235, 237 and 239 have cast semi-steel bodies and are suitable for steam pressures up to 250 lbs. No. 333, 335 and 337 have forged steel bodies with either screwed or flanged connections. See chart below for capacities.



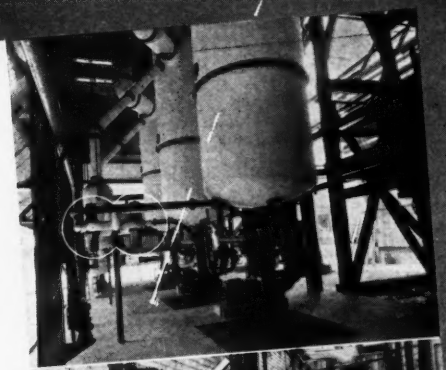
FOR CATALOG

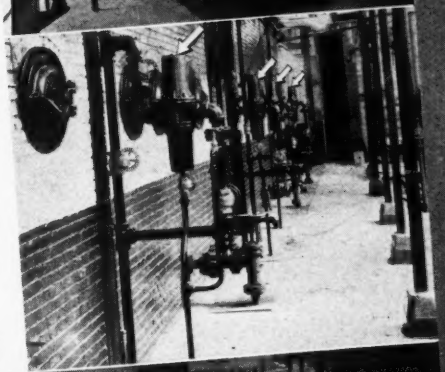
● Detailed specifications and information about Armstrong Compound Traps are printed in Catalog H. Ask for a copy.

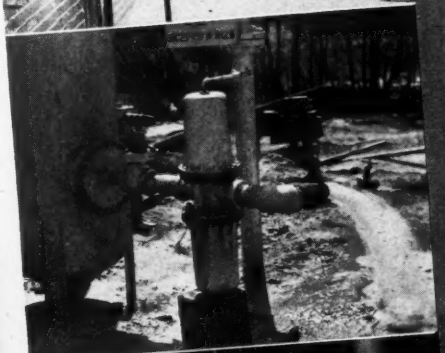
ARMSTRONG MACHINE WORKS
810 Maple Street
Three Rivers, Michigan

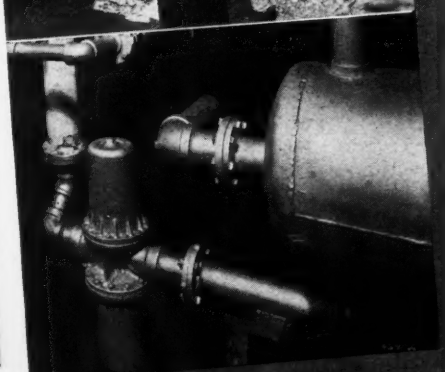
ARMSTRONG Piston Operated

CONDENSATE DRAINAGE *Jobs*









QUICK ACTING. Armstrong Piston Operated Compound Traps get rid of big slugs of water in a hurry without any steam loss. Completely automatic. The capacity curves shown at left are drawn from actual tests with hot condensate. The valve action is fast and positive.

SINGLE, SELF-CONTAINED UNIT. Entire mechanism for handling BIG drainage jobs is housed in a compact assembly and actually consists of only three moving parts.

HIGHLY DEPENDABLE. No springs . . . no closed floats . . . no adjustments to make. You get all the advantages of standard Armstrong traps: non-air-binding . . . self-scrubbing . . . tight closing, no wire-drawing . . . valves water-sealed at all times . . . all-stainless steel interior mechanism.

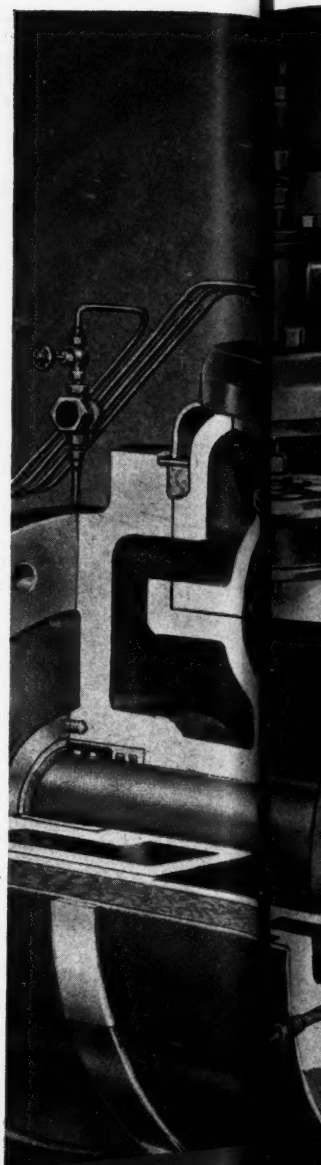
MANY USES:

● Following is a summary of a few typical installations of Armstrong Compound Traps:

Trap:	Pressure:	Draining:
No. 235	165 lbs.	Marley Purifier
No. 333	300 lbs.	Ross Heater
No. 237	175 lbs.	Swenson Evaporator
No. 335	650 lbs.	B & W Separator
No. 235	150 lbs.	Mica Press
No. 337	450 lbs.	Hagan Purifier
No. 235	150 lbs.	Sand Dryer
No. 233	200 lbs.	Creosoting Cylinders
No. 235	140 lbs.	Griscom-Russell Extraction Heaters
No. 233	65 lbs.	Alum Cooking Vats
No. 335	1100 lbs.	Gas Well Separator
No. 237	15 lbs.	Paper Machine Dryers
No. 235	150 lbs.	Centrifix Separator
No. 235	125 lbs.	10,000 gal. Sims Water Heater
No. 437	1000-150 lbs.	Desuperheater
No. 337	450 lbs.	Boiler Dry Drum
No. 237	175 lbs.	Morterud Heaters
No. 235	80 lbs.	Oil Separators
No. 235	50 lbs.	Pulp Digester Heater
No. 233	5-110 lbs.	Salt Gainer Pan
No. 237	200 lbs.	Continuous Blow-down System

COMPOUND TRAPS

When It "Groans" It's "Sick"!



BUT EVEN A QUIET-RUNNING JOB DOES NOT ALWAYS MEAN MAXIMUM EFFICIENCY!

Problem: Operating men know that "groans" warn of an engine "sick" from inadequate lubrication. This can result in excessive friction, wear, and blow-by.

Equally important—they know that even a *quiet-running steam engine* may be building up "trouble"... if it's overlubricated. A surplus of lubricant can cause oil in boilers, low heat transfer, danger to tubes and impaired boiler efficiency.

Answer: Use a cylinder oil that will prevent "groaning," yet permit minimum application.

Gargoyle Cylinder Oils fit the bill. They maintain a tough, adhesive film on piston and cylinder walls, even when applied in restricted feeds. And they separate quickly from steam condensate to minimize the amount of oil carried back into the boiler.

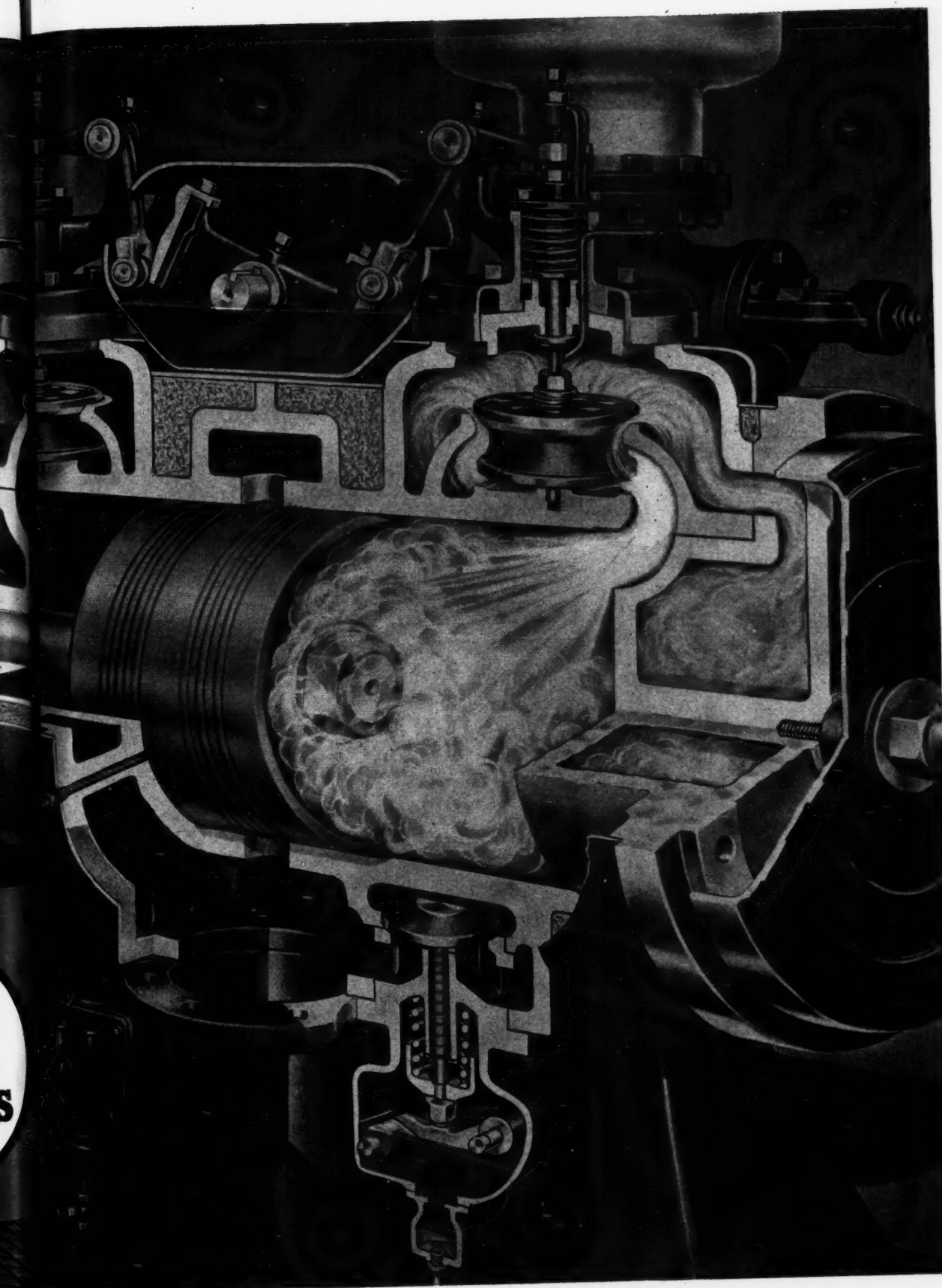
The Socony-Vacuum man who visits your plant can recommend a *correct* Gargoyle Cylinder Oil for your steam engines to fit every conceivable set of operating conditions.

TO HELP MAINTAIN WARTIME PRODUCTION, CALL IN

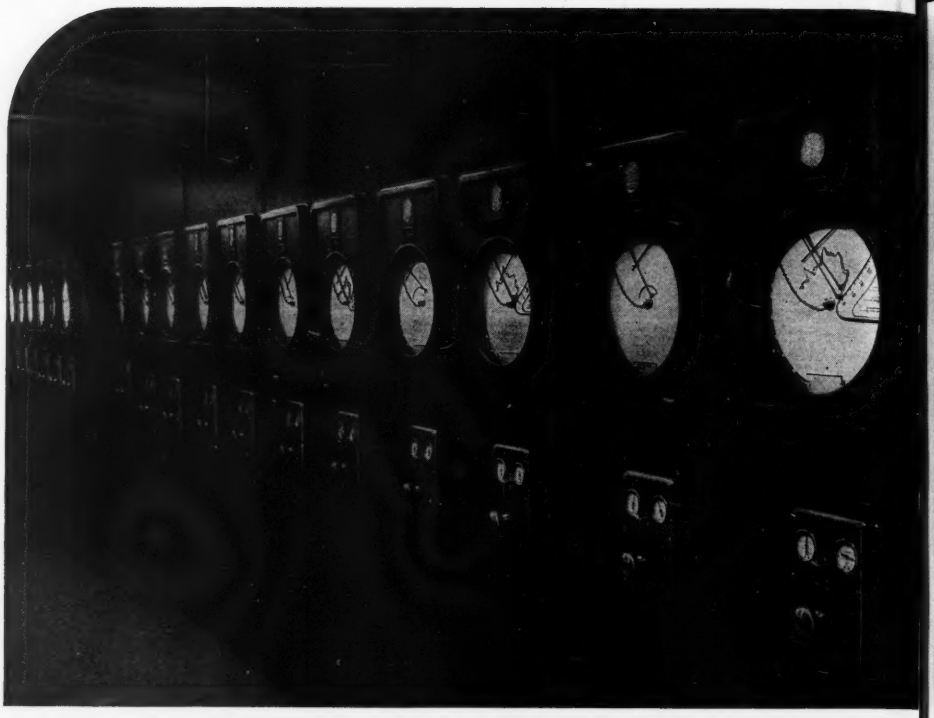
SOCONY-VACUUM for "Correct Lubrication"

GARGOYLE Lubricants

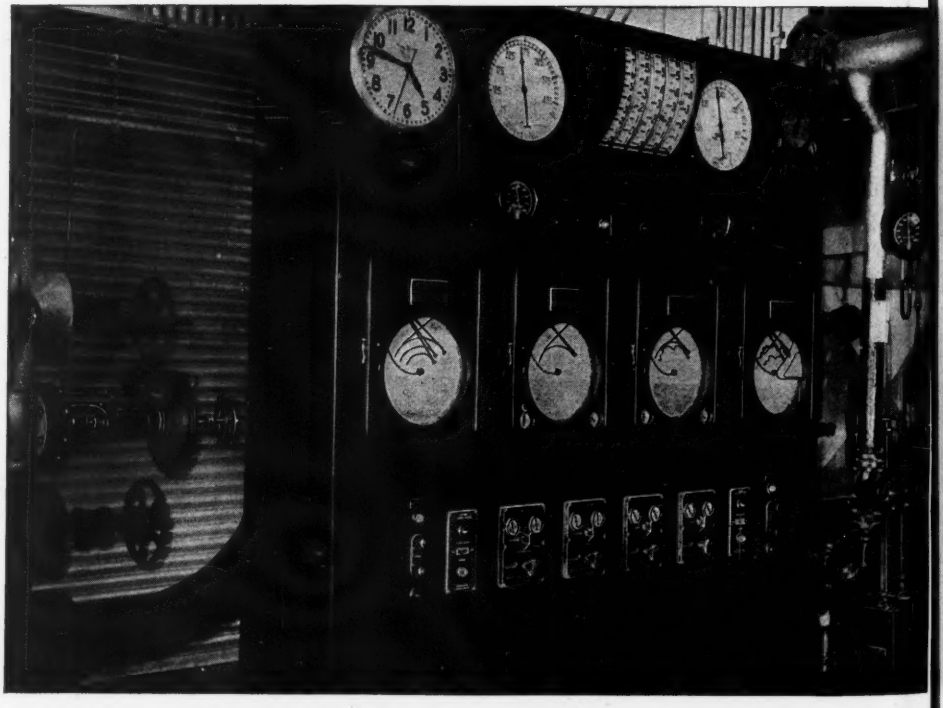
SOCONY-VACUUM OIL CO., INC. — Standard Oil of N. Y. Div. — White Star Div. Lubrite Div. — Chicago Div. — White Eagle Div. — Wadhams Div. — Southeastern Div. (Baltimore) — Magnolia Petroleum Company — General Petroleum Corporation of Calif.



HELP FOR THE BATTLE OF



These Bailey Meters and Controls insure maximum steaming capacity, minimum "time out" for repairs; and most economical use of fuel in a steel mill and a chemical plant.



BAILEY METER CONTROL

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

E OF 168 HR. PRODUCTION

Production for victory under the 168-hour week will try the soul of many a power plant engineer.

Steaming capacity will have to be stretched to the limit. Shutdowns for maintenance will result in lost production. Certain fuels will not be available and all fuels will have to be used with economy. Trained men will become scarce.

Under these conditions we will have to make the most of what we have. To help power engineers win the battle of 168-hour steam production, Bailey Meter Company has published a bulletin, "How to Safely Stretch Steaming Capacity".

This bulletin makes numerous fundamental suggestions which can be carried out without the use of elaborate metering or control equipment. It also explains how the proper use of metering and control equipment:

1. Stretches steaming capacity.
2. Avoids frequent shutdowns for maintenance.
3. Insures safety of men and equipment.
4. Furnishes data for comparison of fuels.
5. Reduces consumption of fuel.
6. Maintains efficiency while training new operators.

These suggestions will help you win the battle of 168-hour production. Ask for Bulletin No. 16. It will be sent without obligation of any kind.

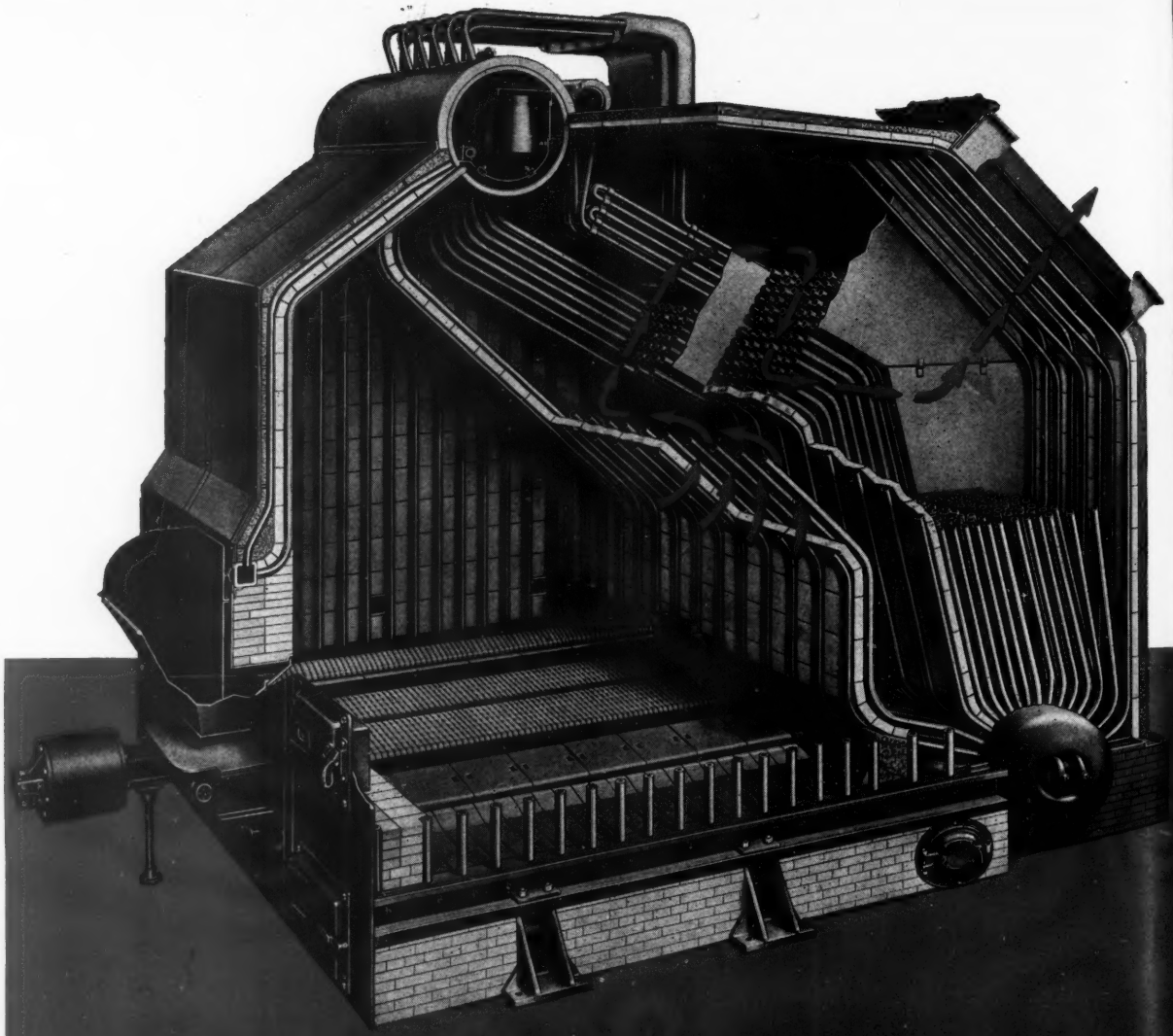
BAILEY METER COMPANY
1040 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

BAILEY METERS

The Complete Combustion Control System

ONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL

Economical STEAM PRODUCTION FO



B & W INTEGRAL-F

...NFOR *Smaller* PLANTS ALSO

Many of the B&W principles upon which hundreds of the great utilities rely for the economical production of steam are now available also to plants of smaller capacity—as low as 9000 pounds of steam per hour—in the Babcock & Wilcox Integral-Furnace Boiler, Classes 9, 12 and 15.

One of these principles, used in central stations generating an aggregate of more than 18 million pounds of steam per hour is the furnace arrangement in which the primary combustion zone is followed by an open pass. With this design the gases are thoroughly mixed while at high temperatures, thereby aiding in efficient and smokeless combustion.

For many reasons besides that of efficient combustion, B&W Integral-Furnace Boilers are a logical choice for small, as well as larger plants—reasons such as simplicity of operation, and low maintenance. Bulletin G-34-A tells the story. Write for your copy.

THE BABCOCK & WILCOX COMPANY · **85 LIBERTY STREET, NEW YORK**

PRODUCTS OF

THE BABCOCK & WILCOX COMPANY

AND SUBSIDIARIES

B&W Water-Tube Boilers
Stirling Water-Tube Boilers
Type H Stirling Water-Tube Boilers
Integral-Furnace Boilers
Waste-Heat Boilers
B&W Marine Water-Tube Boilers
B&W Express-Type Marine Boilers
Bailey Water-Cooled Furnaces
Superheaters
Desuperheaters
Economizers
Air Heaters
Pulverized-Coal Equipment
Chain-Grate Stokers
Oil Burners
Gas Burners
Multifuel Burners
Stacks and Breechings
Seamless Steel Tubes and Pipe
Seamless Alloy Tubes and Pipe
Seamless Toncan Iron Tubes
Alloy Pipe Fittings
Refractories
B&W 80 Firebrick
B&W Junior Firebrick
B&W Insulating Firebrick
B&W Refractory Mortars and Plastics
Process Equipment
Pressure Vessels, Tubular Products
Alloy Castings
B&W-Tomlinson Recovery Process
Pulverizers for Cement Materials, Rock Products, and Ores
Alloy Castings, Elverite Castings
Adamantine Castings

G-218 T

...-FURNACE BOILER

RELIABILITY FIRST!

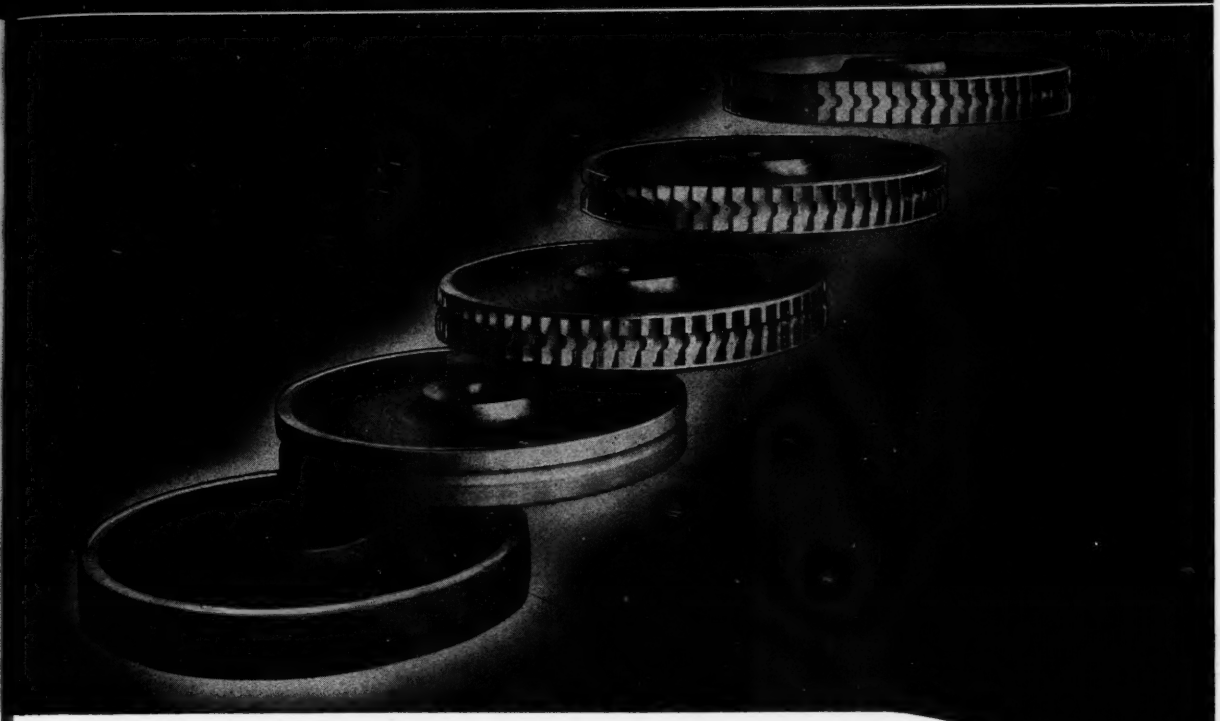
Throughout the entire forty-nine years that the Terry Turbine has been on the market it has always been the Terry policy to build first of all for reliability.

That this policy has been appreciated is proven by the very extensive use of Terry turbines where only the most trustworthy apparatus is permissible; namely in outstanding central stations, leading industrial plants and on large Naval vessels. The Terry today still maintains that preeminent position in these most exacting fields which it immediately took upon its introduction.

At Left:—

Action of steam in Terry wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket in which its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

THE TERRY STEAM TURBINE CO.



STEPS IN THE MACHINING OF A TERRY TURBINE WHEEL — From left to right:
1. Rough turned forging. 2. Smooth turned. 3. First milling cut. 4. Second milling cut. 5. Finished wheel.

TERRY WHEEL TURBINE ADVANTAGES

— The blades and the wheel are in one piece so that there are no parts to become loose or work out.

— The blades have large clearances.

— The blades are double rim protected.

— End play will not damage the blading.

— It is impossible for the blades to foul.

— The power producing action of the steam in the wheel takes place on the curved surfaces at the back of the buckets and, therefore, close blade clearance is not necessary.

— The only function of the blades is to form a series of pockets, wear of the blade edges is of little consequence and does not materially affect the horse power or efficiency. The important part of the bucket is the back or bottom which is a solid forging.

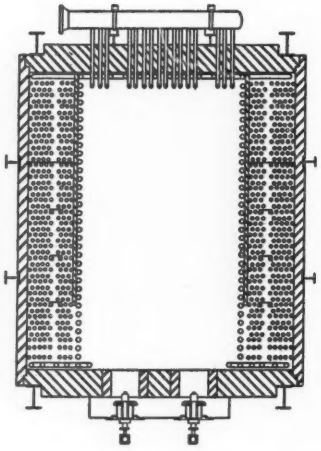
— There is practically no end thrust since the steam enters and leaves the wheel in a direction at right angles to the shaft.

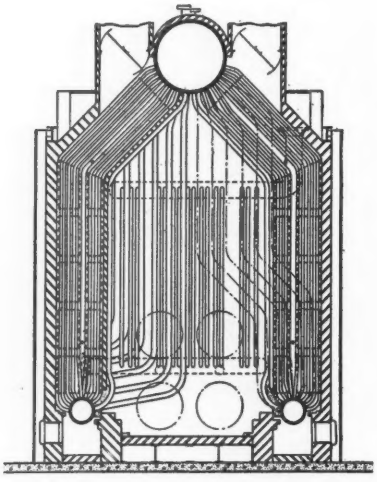
ASK FOR BULLETIN S-116

T-1143

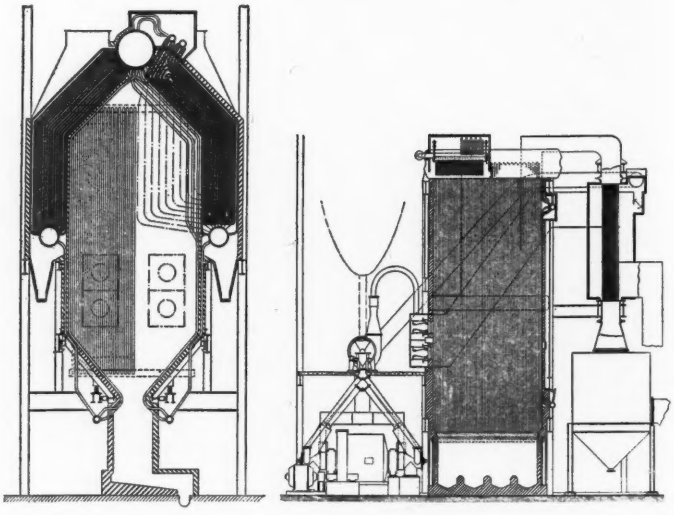
TERRY SQUARE - HARTFORD, CONN.

STEAM GENERATORS





"S-A" steam generator of the Socony-Vacuum Oil Co., Inc. Steam capacity 75,000 lb. per hour. Pressure 160 lb. per square inch.



One of the "S-A" type steam generators of the Shell Oil Co. Steam capacity 175,000 lb. per hour. F.S.T. 750° F. Pressure 700 lb. per square inch.

REPEAT ORDERS

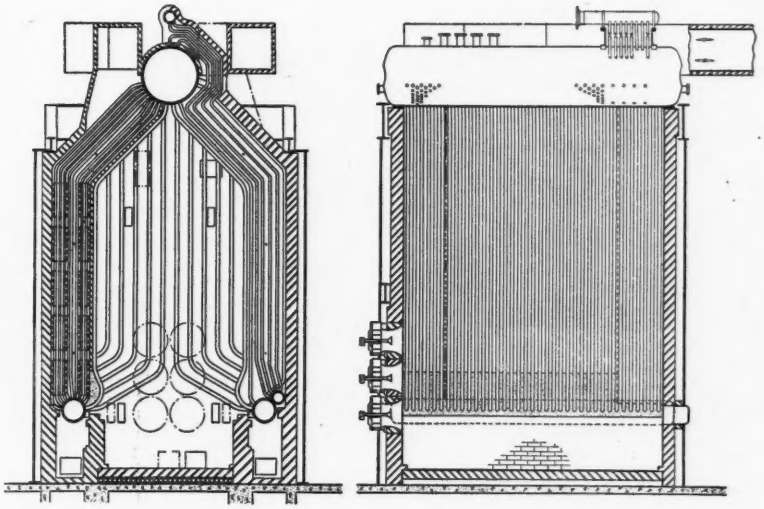
During the last five years more than 160 steam generators have been furnished to the Petroleum Industry by Foster Wheeler—in many countries.

Repeat orders are surest indication of satisfaction as to reliability, efficiency, and overall costs—44 orders placed by experienced users for additional steam generators is conclusive proof of performance.

FOSTER WHEELER CORPORATION.

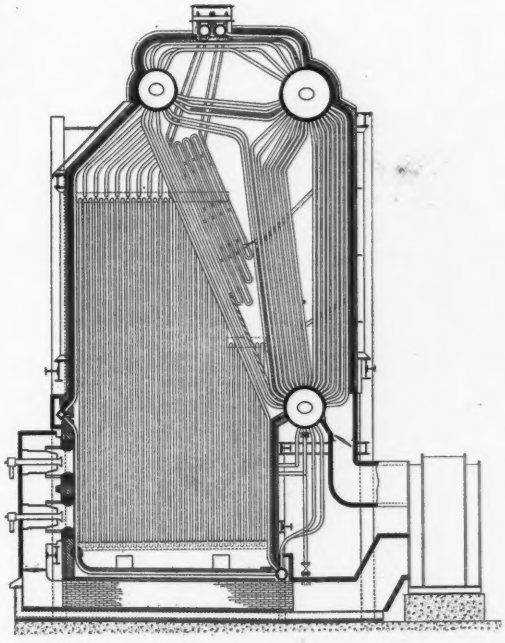
FW FOSTER

FOR THE OIL INDUSTRY



Right: Steam generator of the "S-A" type for a prominent British oil refinery. Steam capacity 75,000 lb. per hour. F.S.T. 435° F. Pressure 250 lb. per square inch.

Right: One of the 675 lb. per square inch pressure steam generators for The Texas Company's Port Arthur Refinery. 225,000 lb. per hour at 715° F.—largest outdoor units in this country.



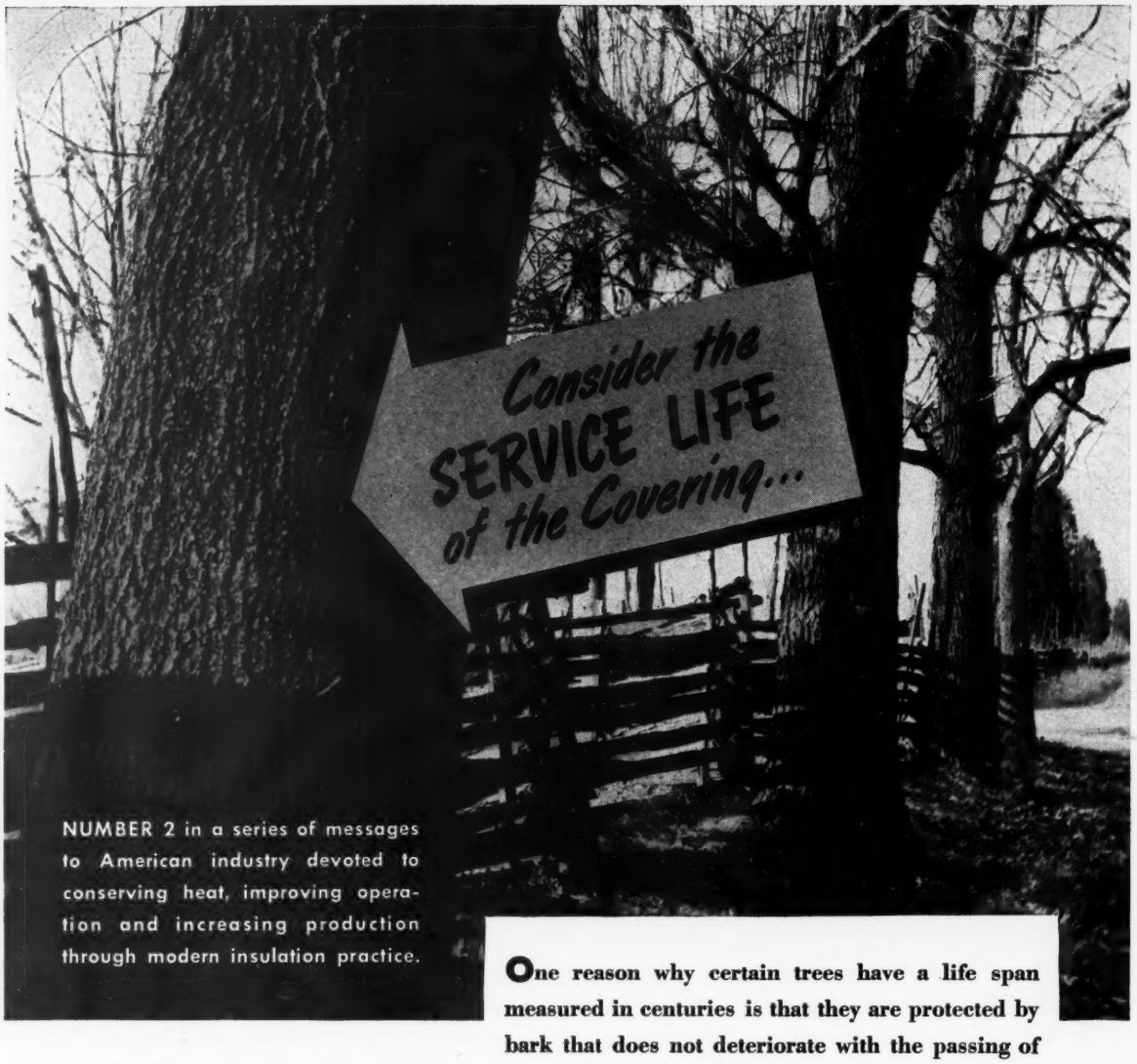
44 YEARS EXPERIENCE

For 44 years Foster Wheeler has sold steam generator equipment to the oil industry. Today, as in the past, we are playing an integral part in the industry's rapid development.

165 BROADWAY, NEW YORK, N. Y.

WHEELER

GETTING THE *MOST* FROM YOUR THERMAL INSULATIONS...



NUMBER 2 in a series of messages to American industry devoted to conserving heat, improving operation and increasing production through modern insulation practice.

One reason why certain trees have a life span measured in centuries is that they are protected by bark that does not deteriorate with the passing of the years. Similarly, some insulating materials, such as Ehret's 85% Magnesia, have a proven record of long service life and a time-tested ability to maintain initial insulating efficiency.

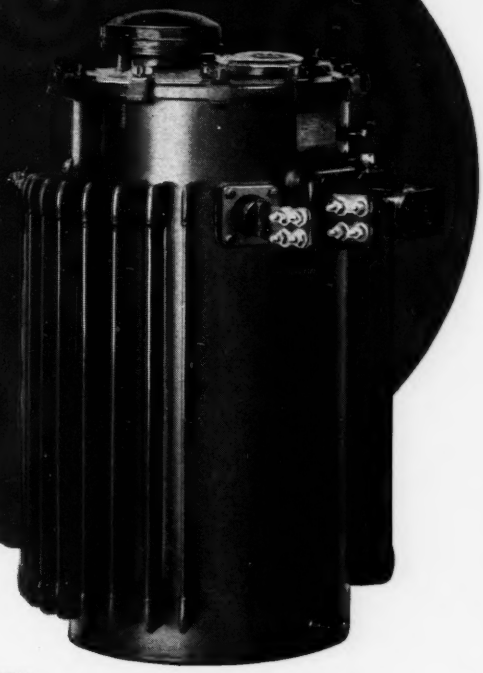
Under the stress of present day demands on hot piping and equipment, it is all the more important to make certain that you specify only those insulations which have proven performance records.

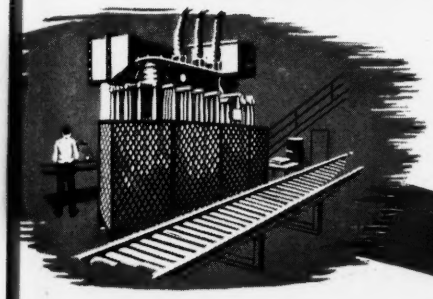
★ **EHRET'S 85% MAGNESIA** and other Ehret heat insulating materials are fully treated from the standpoint of characteristics, selection and application in a new 176-page Heat Insulation Handbook. It will be sent, without obligation, to anyone interested in getting the most from thermal insulations. Write for your copy of Handbook B 204.

EHRET MAGNESIA MANUFACTURING CO.
VALLEY FORGE, PENNA.

...THERE IS AN *EHRET* DISTRIBUTOR OR CONTRACTOR IN EVERY INDUSTRIAL AREA

PYRANOL TRANSFORMERS

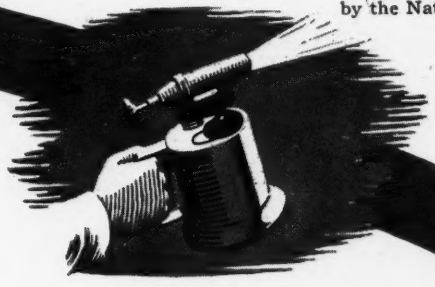




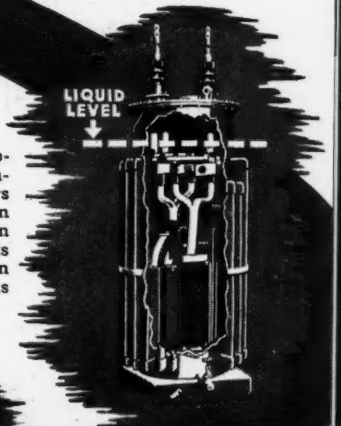
1 *Economical, speedy installation of transformers indoors* was made possible by the introduction of Pyranol* ten years ago. Today, hundreds of utilities, industrial plants, public buildings, and naval and military establishments use Pyranol transformers to supply power for vital production and other war activities.

*General Electric's noninflammable insulating and cooling liquid

2 *You can't burn Pyranol!* No Pyranol transformer has ever burned, or contributed to a fire! This record covers installations of more than 8,000 transformers, ranging in size from 1½ to 12,000 kva, and totaling more than 2,000,000 kva. It fully justifies the recognition given Pyranol transformers by the National Electrical Code.



RIGHT now, safety and reliability of power supply are of paramount importance. Investigate the benefits of Pyranol transformers—especially indoor installations—when you need added transformer capacity. Compared with conventional outdoor installations, you'll make major savings—in time, construction materials, and in copper. Thousands in use prove it. Ask your G-E representative for complete information. Or, write for Bulletin GEA-2048C. *General Electric, Schenectady, N. Y.*

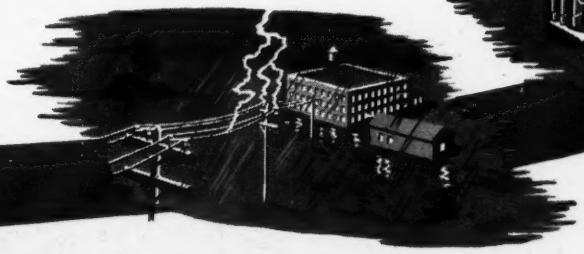


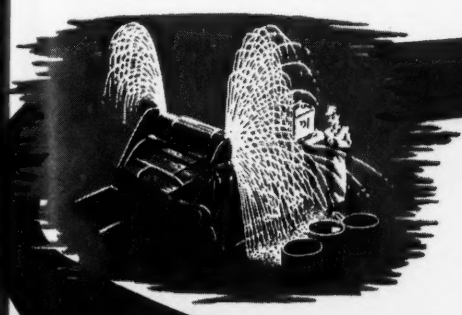
3 *The reliability of Pyranol transformers* is appreciated by users. It is based on design principles that have made liquid-filled transformers the most nearly trouble-free electric apparatus in service today. Heat-storage capacity—inherent in liquid-filled transformers—makes Pyranol units ideal for sustained emergency overloads. Immersion of the transformer interior in Pyranol prevents drying and cracking of the winding insulation.

GENERAL ELECTRIC

402-42-5100

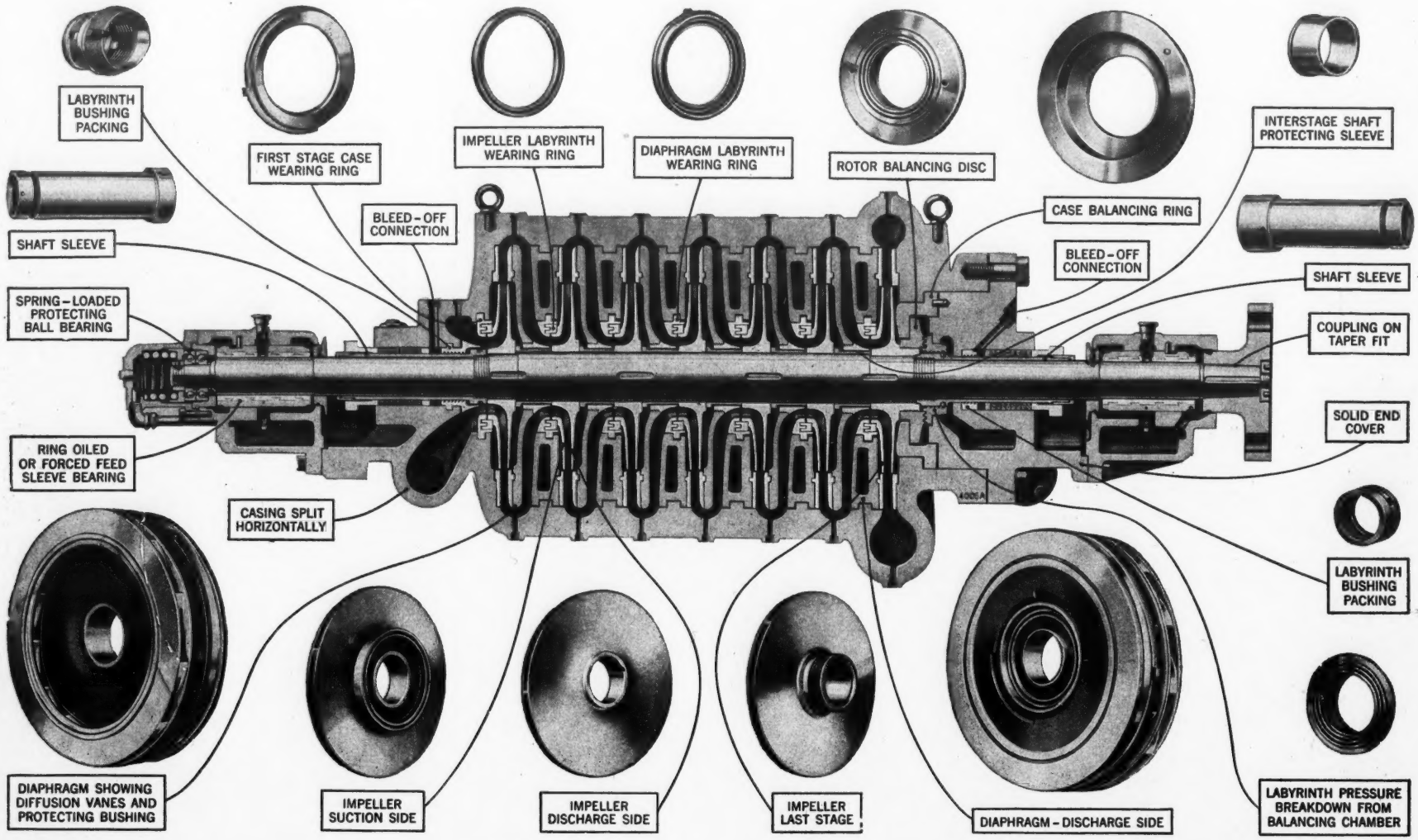
General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.





5 *Little, if any, maintenance.* The sturdy tank, all-welded by electric process, protects vital parts of the transformer against sabotage and the entrance of moisture, dirt, dust. Pyranol is nonoxidizing, nonsludging. Years of use do not impair its insulating properties.

4 *High dielectric strength* both at normal frequency and impulse gives Pyranol transformers great ability to withstand voltage surges that originate from switching operations or lightning.



DE LAVAL BOILER FEED PUMP

Points subject to wear are protected by inexpensive renewable parts. Full particulars in Catalog P-3617. De Laval Steam Turbine Co., Trenton, N. J.

HOW MANY H.P. in Your Unit of Fuel?

The answer depends upon two factors—the B. T. U. rating of the fuel itself—and your ability to convert into useful work a high percentage of those B. T. U's.

Getting maximum steam output from fuel is not a "gift" these days. The secret is contained in treating the complete power plant as a unit. Whether you burn oil, gas, or coal, the starting point in reduction of power costs is the accurate measurement of flows, $\%CO_2$, temperatures, pressures, drafts and liquid levels.

Regardless of the size of the plant, Brown Indicating and Recording Instruments furnish the essential information to operators and engineers which enables them to obtain the maximum steam output.

BROWN FLOW METERS . . . provide records of individual boiler output and steam consumption of various units and departments—the rate and quantity of water fed to each boiler permitting check on blow-down and boiler feed radiation.

BROWN CO_2 METERS . . . when used as a firing guide, enable operators to hold the correct per cent CO_2 and prevent fuel losses due to improper fuel-air ratios.

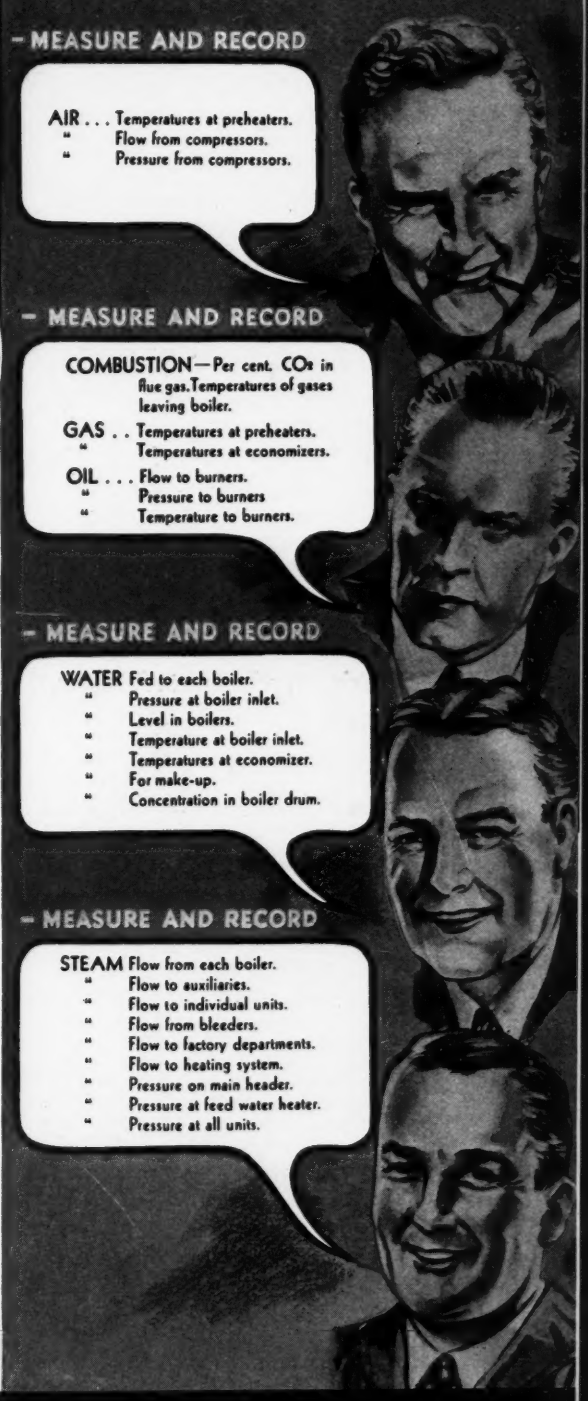
BROWN PYROMETERS AND THERMOMETERS . . . are essential guides in checking air, gas, water and steam temperatures.

BROWN PRESSURE GAUGES . . . aid in maintaining correct Drum, Header and Line Steam Pressures as well as pressure drop across regulating valves.

The continuous chart records reveal instantly any deviation above or below the most efficient operating conditions. By analyzing chart records of flow, $\%CO_2$, temperature, pressure, liquid level, etc., management can properly allocate costs and increase the standard of operating efficiency.

BROWN Engineers will be glad to recommend the instruments most suitable for your boiler room or plant requirements. Write for catalogs. THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4491 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Toronto, Canada: 117 Peter Street—Stockholm, Sweden: Nybrokajen 7—England: Wadsworth Road, Perivale, Middlesex.

Definite Ways - to REDUCE POWER COSTS . . .


- MEASURE AND RECORD
AIR . . . Temperatures at preheaters.
" Flow from compressors.
" Pressure from compressors.
- MEASURE AND RECORD
COMBUSTION—Per cent. CO2 in flue gas. Temperatures of gases leaving boiler.
GAS . . Temperatures at preheaters.
" Temperatures at economizers.
OIL . . . Flow to burners.
" Pressure to burners
" Temperature to burners.
- MEASURE AND RECORD
WATER Fed to each boiler.
" Pressure at boiler inlet.
" Level in boilers.
" Temperature at boiler inlet.
" Temperatures at economizer.
" For make-up.
" Concentration in boiler drum.
- MEASURE AND RECORD
STEAM Flow from each boiler.
" Flow to auxiliaries.
" Flow to individual units.
" Flow from bleeders.
" Flow to factory departments.
" Flow to heating system.
" Pressure on main header.
" Pressure at feed water heater.
" Pressure at all units.

BROWN INSTRUMENTS

AND MINNEAPOLIS-HONEYWELL CONTROL SYSTEMS

For Temperatures . . . . . Pressures . . . . . Flows . . . . . Liquid Levels

Catalog P-3017. De Laval Steam Turbine Co., Trenton, N. J.

Keep Your Production Rollin'!

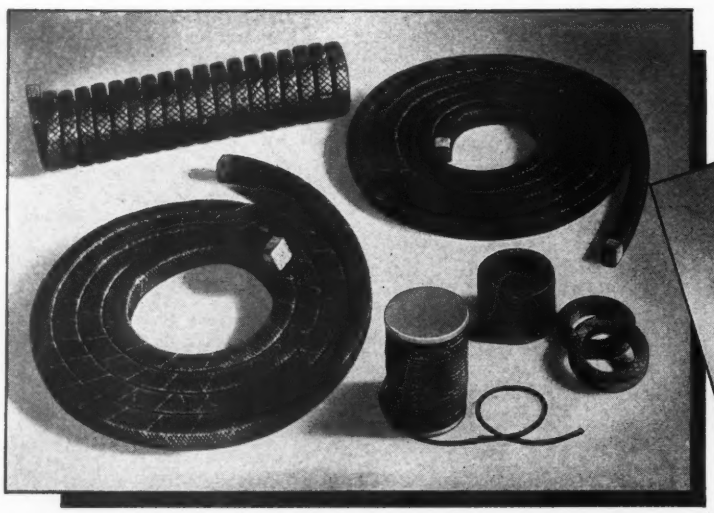
Every time a piece of essential equipment is tied up for re-packing or for replacement of gaskets, Victory is delayed a little.

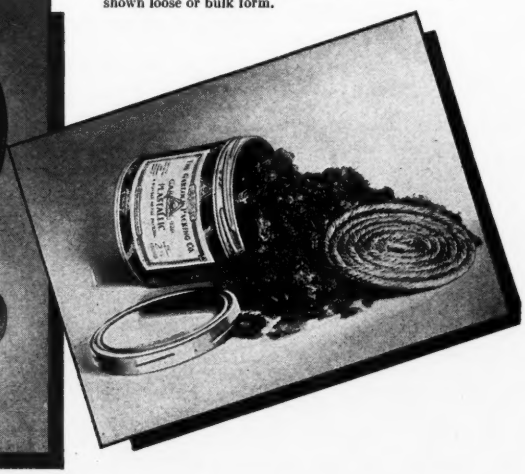
Let's avoid every possible interruption of our all-out production. Use *quality* packings and gaskets for long, dependable service—specify GARLOCK!

GARLOCK

The Standard Packing of the World

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.





Garlock *Plastallic* Packings are compounded to Garlock formulae for various services. Easy to apply. In service, *Plastallic* combines into one homogeneous mass. Photo at left shows coil, spiral and ring forms. Below is shown loose or bulk form.

Local Turbulence Creates Rapid Tube Failure

Tubes consistently failed at the second-pass inlet end. Inspection revealed that the reverse-flow waterbox was divided horizontally at the center by an open reinforcing diaphragm which had openings which constituted only 56% of its area. These restricted openings caused increased local velocity and turbulence, with resultant release of air from solution. The changes recommended by Scovill were inexpensive and entirely successful in stopping the rapid second-pass tube-end failure.

You may see yourself in this book

and Find You've Helped to Write It

You may "find yourself" in the pages of Scovill's condenser and heat exchanger literature, for it is based on the practical experience of men like yourself, many of them with problems Scovill helped to solve.

You may even find that you've helped to write it for, in a sense, this literature is written *by* power plant, marine and refinery engineers as well as *for* them. It is the result of collaboration between Scovill's consultants-in-the-field, Scovill's laboratory researchers and Scovill customers with condenser or heat exchanger tube problems.

Scovill service in manuals — one of its three services to tube users — is available in two forms: "Condenser Tube" literature dealing with corrosion of metals and alloys, selection of tube material, tube installation methods, tube specification and general data tables . . . for engineers dealing with operation and maintenance of condensers and heat exchangers; and a "Heat Exchanger Tube Manual" with additional articles on fluid flow, heat transfer, steam condensation and oil tables . . . for engineers primarily interested in construction and design problems.

This Scovill service in *manuals* is backed up by Scovill's two other condenser tube services — in *men* and *metals* — all available to help you get the most out of your condenser and heat exchanger equipment. Address 17 Mill St., Waterbury, Connecticut.

★ ★ ★ ★ ★ ★ ★

Scovill, for many years a regular source of supply for the United States Government, is cooperating in every way to forward defense plans. When deliveries are not as prompt as our customers desire, we hope they will realize that delays are sometimes unavoidable and part of the price paid for national defense.

SCOVILL
Masters of Metal

Scovill Condenser Tubes

ONE PRODUCT...THREE SERVICES

- **SERVICE IN MEN**
- **SERVICE IN METALS**
- **SERVICE IN MANUALS**

TO WIN BATTLE OF PRODUCTION IS *your* DUTY

Four ways ELGIN PRODUCTS can help

1

ELGIN "DOUBLE-CHECK" PRINCIPLE applied to your present water softener practically double its efficiency.

- Increases water softening capacity as much as 44%.
- Prevents loss of zeolite.
- Cuts salt consumption.
- Stops packing and channeling of zeolite bed.
- Improves backwashing, making softeners self-cleaning.

[New Elgin "Double-Check" Type Softeners are built on this principle]

FACTS IN BULLETIN 605

2

ELGIN CHEMICAL TREATMENTS individually formulated to protect and prolong life of equipment include:

- Boiler water treatment.
- Process water treatment.
- Hot water treatment.
- Cooling water treatment.
- General cold water treatment.

Testing Equipment

[*Water analysis and Consultation Service—without charge*]

FACTS IN BULLETIN 550

3

ELGIN HEAT EXCHANGERS

(Continuous Blowdown Systems for boilers) save fuel; step up efficiency.

- Maintain correct soluble concentration of boiler water for production of clean dry steam.
- Assure uniform blow down rates despite wide variations in boiler load — eliminating large wasteful blowdowns at peak loads.
- Save fuel by increasing feed water temperature.

FACTS IN BULLETIN 510

4

ELGIN DECONCENTRATORS keep boilers in efficient operation and cut steam production costs.

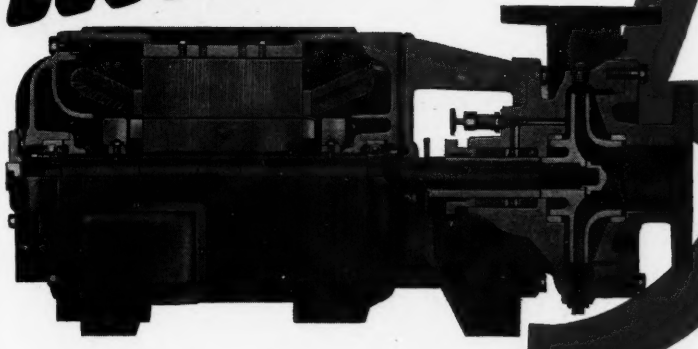
- Keep boilers free of mud, sludge and scale.
- Cost less to install because less material is required.
- Eliminate the necessity of expensive auxiliary equipment.
- Complete the water conditioning job by removing residual hardness and after precipitations where lime-soda softeners are in service.
- Easy to operate—require minimum space—applicable to a wide range of conditions.

FACTS IN BULLETIN 500

ELGIN SOFTENER CORPORATION, 136 North Grove Avenue, Elgin, Illinois

WATER CONDITIONING PRODUCTS

ALLIS-CHALMERS ELECTRIFUGAL PUMP



5-WAY WINNER!

Allis-Chalmers Electrifugal "One Package" Pumps . . . in Sizes ½ HP to 25 HP . . . Solve Your Wartime Pumping Problems!

BETTER in 5 important ways . . . the new Allis-Chalmers line of Electrifugal Pumps has *everything it takes* to do an efficient wartime pumping job!

Check the points yourself . . . they stack up into 5 big reasons why this pump can give you new highs in pumping performance —

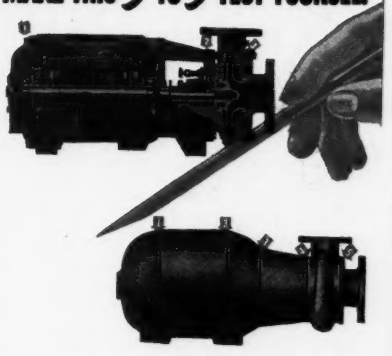
Space saved — up to 33%
Pump Overhang Cut—as much as 40%
2 Section-Fits Eliminated
Splash-proof Motor
Easy-to-get-at Casing

And remember — these points are *in addition* to the regular features that have long made Allis-Chalmers centrifugal pumps tops in the industrial field. Indestructible rotor . . . distortionless stator . . . large, sturdy ball bearings . . . cast bronze protective sleeves . . . and many other extra-value features are yours.

If you have a wartime pumping problem and want *more gallons* with greater *dependability* than you've ever had before, here's the pump for you — for as much as 33% less than the cost of conventional motor and pump installations.

To get the whole story, call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wis. A 1494

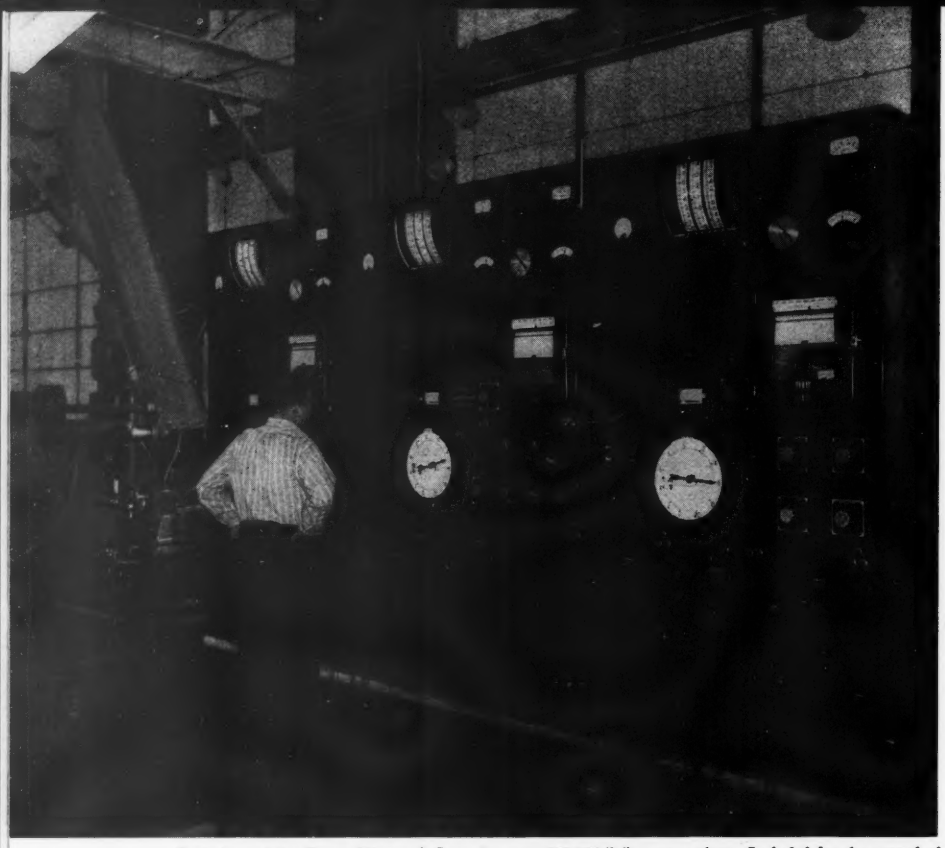
MAKE THIS 3 TO 5 TEST YOURSELF



The NEW Allis-Chalmers Electrifugal Pump has only three section-fits compared to five or more for old style pumps! That means more perfect alignment of the shaft . . . less vibration . . . less wear . . . less trouble. Here's a pump that gives you more gallons . . . for less cost!

Allis-Chalmers Pumps Can Cut Your Pumping Costs

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN



Control panel for Henry Disston & Sons, Inc. new 200,000-lb/hr power plant. Included for the control of their three Riley steam-generators are Metermax Combustion Control, Micromax Temperature Recorder and Micromax CO_2 Recorder.

NEW DISSTON POWER PLANT

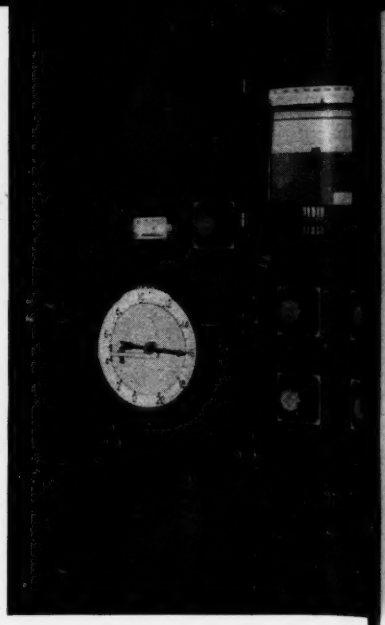
Instrumented Like a Central Station

When the Disston engineers came to the point of specifying the control instruments for their new 3-boiler, 200,000-lb/hr power plant, they were in something of a quandary. Not for many years had the Company purchased combustion controllers, CO_2 recorders, or steam-temperature recorders; and, without some experience in such devices to guide them, the proper selection was a problem.

But, Disston had long been using temperature-controlling instruments, in the melting, rolling, hardening and tempering of the steel used in the manufacture of saws, files, knives, armor plate, etc. Many dozens of those instruments were L&N, and were giving extremely satisfactory service. Why not, then, reach over into the manufacturing department's experience, and specify L&N for the power plant?

Operations to date have amply justified the decision. The Metermax Combustion Control gives boiler operators a control distinguished for completeness and flexibility; a control which handles even the heaviest load swings with ease and smoothness . . . The Micromax temperature recorders supply multipoint records of steam, water, flue gas and air, with the greatest dependability and with outstanding clearness and legibility . . . And the Micromax CO_2 Recorders are proving here, as they have proved in dozens of other plants, that CO_2 can now be recorded as easily, as accurately and with as little maintenance on the instrument as is the case with temperature.

All these instruments are described in well-illustrated catalogs; just send for the ones which interest you.



Close-up of Panel

Many an engineer who likes the clear, sharp records of the Micromax Multi-point Temperature Recorder will be glad to know that those records can now be filed in such a way that they can be consulted without having to unroll the used chart. Recorders simply have a "tear-off device", which permits removal of chart every day, or as often as desired. Folded once, the torn-off 24-hour record fits a standard desk file. The strip-chart Micromax, shown above on the Disston control panel, has this tear-off device; the tape which is clipped to the torn edge reduces the consumption of chart paper to a minimum.

At the bottom of the panel are the Micromax Round-Chart CO_2 Recorder, the push-buttons for Metermax Combustion Control and the Controllers. These last instruments regulate the fuel feed, air flow and furnace pressure by means of electrically-powered drive units. A typical unit is shown herewith, as it is applied to the Atrita mill which feeds the Number One boiler. Further information about Metermax Control is given in Catalog N-01-163, which will be sent on request.

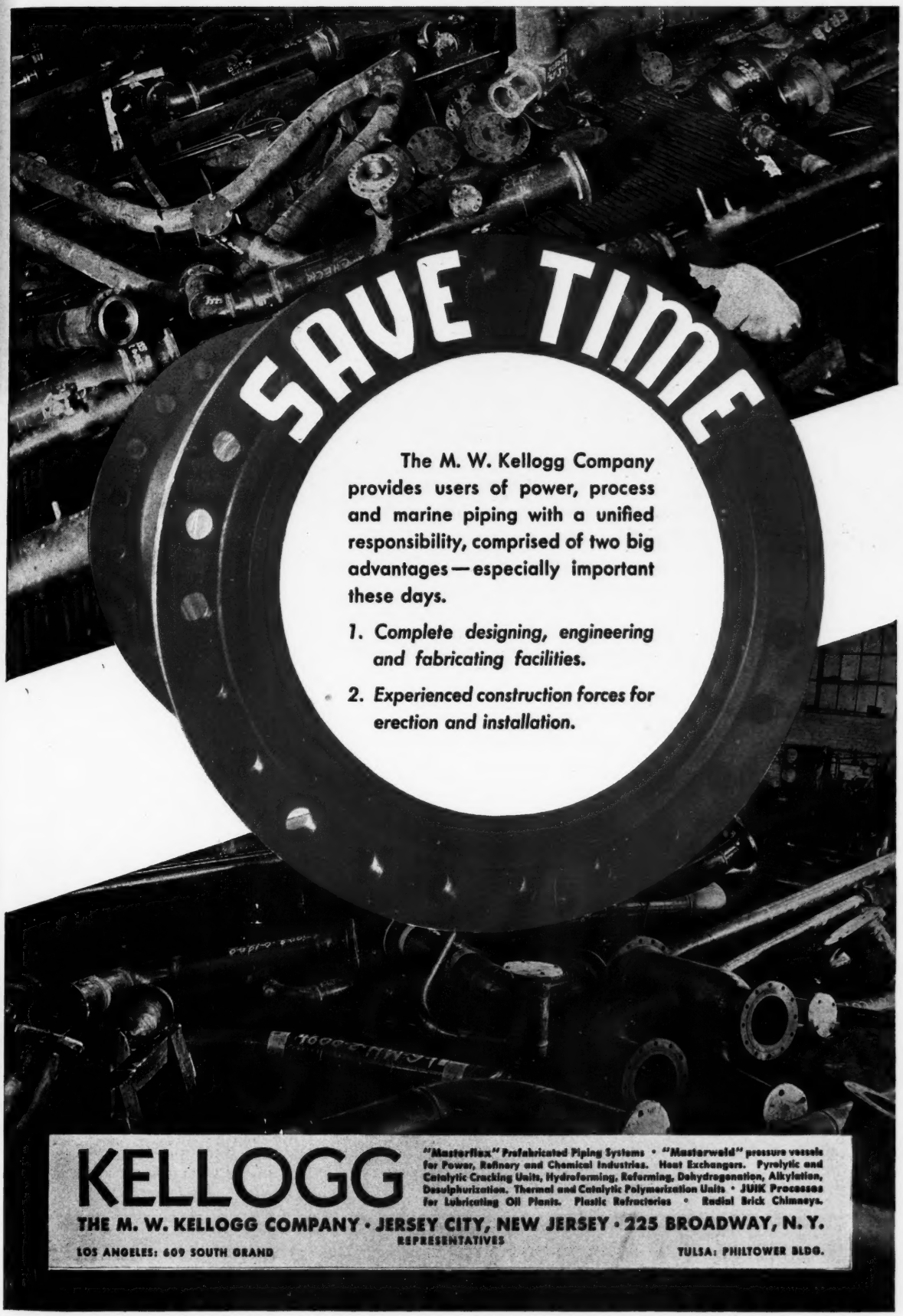
Typical Drive Unit Assembly.

Jrl. Ad. N-163(6)

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS • TELEMETERS • AUTOMATIC CONTROLS • HEAT-TREATING FURNACES


SAVE TIME
The M. W. Kellogg Company provides users of power, process and marine piping with a unified responsibility, comprised of two big advantages—especially important these days.
1. Complete designing, engineering and fabricating facilities.
2. Experienced construction forces for erection and installation.
KELLOGG
"Masterflex" Prefabricated Piping Systems • "Masterweld" pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • JUIK Processes for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.
THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, N. Y.
REPRESENTATIVES
LOS ANGELES: 609 SOUTH GRAND
TULSA: PHILTOWER BLDG.

REPUBLIC INSTRUMENTS AND CONTROLS
EQUIPMENT • FACILITIES • PERSONNEL • EXPERIENCE

THE PROBLEM OF Stretching Capacity

OF EXISTING BOILER EQUIPMENT

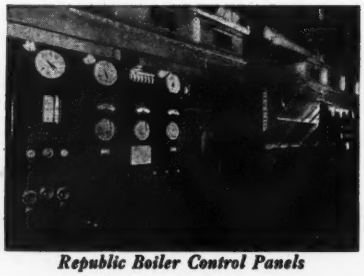
To the power engineer, industry's call for top-speed production is a call for more steam . . . a call which, in many plants, must be met by "stretching" existing generating capacity through shrewd operation, since new steam generating units are not immediately available.

The problem of "stretching" present capacity involves the acquisition of complete knowledge of existing conditions, so that losses in steam generation and distribution may be eliminated and optimum operating efficiency maintained. The correct solution depends on two fundamental procedures. First, the existing conditions must be determined by use of proper instruments. Second, the optimum conditions must be determined and maintained by the use of instruments and by proper methods of control.

Republic offers a complete line of power plant instruments and controls designed and built to meet today's power plant requirements. We will be glad to cooperate with you in the solution of any steam generation or distribution problem you may have.

AUTOMATIC COMBUSTION CONTROL

Republic-Smoot automatic combustion control systems are built for



Republic Boiler Control Panels

all sizes of boilers — all types of fuel firing equipment — all load conditions — any arrangement of draft equipment.

POWER PLANT INSTRUMENTS

Flow meters, draft instruments, CO_2 meters, thermometers — a complete line of power plant instruments, designed and built by Republic, for analyzing and checking plant performance.

BOILER WATER LEVEL CONTROL

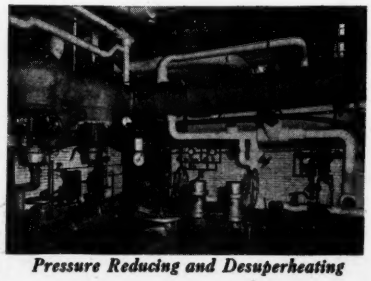
The Republic-Smoot boiler water level control system is designed to maintain boiler drum water level within ± 1 inch of the desired level when the boiler is operating under normal conditions.

REGULATING VALVES

Republic-Smoot turbine type valves are designed for regulating pressure and flow of high-pressure superheated steam or boiler feedwater. They are built for tough jobs in which the valve occupies a key position in the operation of a system or an entire plant.

DESUPERHEATERS

For control of steam temperatures in interconnected systems, several types of Republic-Smoot desuperheaters are available to meet special operating requirements.



Pressure Reducing and Desuperheating

Whether your particular problem involves the use of a single instrument or the control of an entire process or plant, Republic engineers will be glad to study your problem and, in co-operation with your own engineers, make recommendations as to the most practical solution.

Your request for our co-operation in solving your power plant problems will involve no obligation on your part. Write us today.

REPUBLIC FLOW METERS CO.
2224 Diversey Parkway, Chicago, Illinois

2 TO 4 TIMES LONGER OIL LIFE

ON REDUCTION GEAR AND TURBINE

• SAVINGS in oil costs—just count them as incidental, if you wish. But think of the production time you'd save if your reduction gears and oil circulating systems could be operated two to four times as long before they needed cleaning.

A North Dakota power company found that it saved both time and money on the turbine and reduction gear pictured here. With a conventional turbine oil, sludge formed in the units every three to six months. Then, a fill of Stanoil was tried. It ran a full year before it was replaced. Even then, no deposits had formed and the oil was in good condition.

Discuss some of your maintenance problems with a Standard Lubrication Engineer. See if he hasn't a number of suggestions about lubrication that will help you cut down lost machine time. Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois.

Copr. 1942, Standard Oil Company (Indiana)

STANOIL

1. High Viscosity Index. *2.* Low Pour Point. *3.* Unusually High Stability. *4.* Excellent Demulsibility. *5.* Low Carbon-Forming Tendencies.

STANDARD OIL COMPANY (INDIANA)

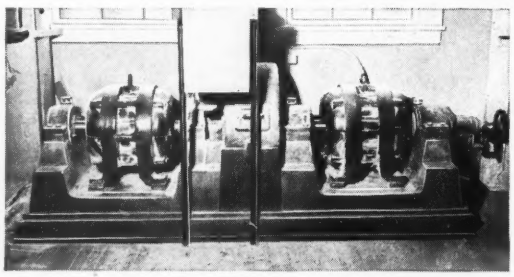
LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION E

...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICAT

CUTS DOWN BEARING REPLACEMENTS WITH . . . SUPERLA GREASE

Frequent requests for replacement bearings from certain customers were worrying the manufacturer of an attrition mill. Why did some have this bearing trouble while others were getting excellent bearing life?

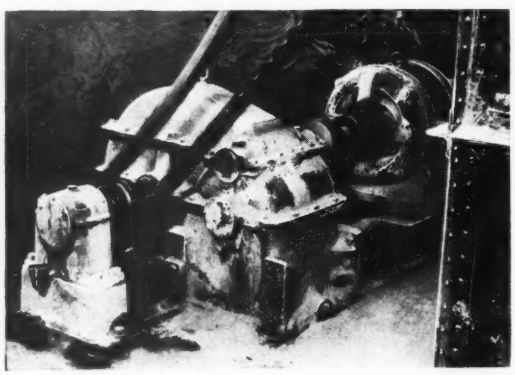
A brief survey in the field soon uncovered the reason—poor lubrication. He decided that his job wasn't finished when he built a well designed, efficient mill. Exhaustive tests were made of various greases, including Superla Grease—a Standard Oil Engineer's recommendation. Because of the unusual results obtained, a 10-pound package of Superla is now shipped with every machine. Bearing complaints are practically eliminated where the manufacturer's lubricating instructions are followed.

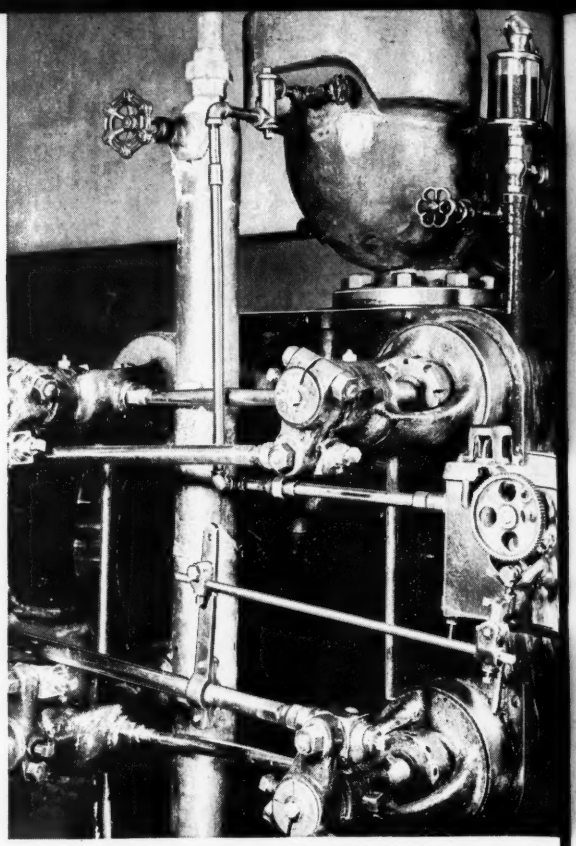


Whether you manufacture or operate grease lubricated equipment, a Standard Lubrication Engineer will be glad to show you how Superla can help you avoid bearing trouble.

STANOIL KEEPS GEAR CASES CLEAN ON SPEED REDUCERS

Is 24-hour operation increasing the maintenance of your power transmission equipment? For example, do speed reducers require more frequent oil changes? Are deposits building up faster in the gear cases? See if you can avoid the increased labor and lost machine time they'll cause. Test a fill of Stanoil in one of your speed reducers. Watch how long it stays clean and free from any sign of asphaltic deposits or sludge—usually two or three times as long as a conventional engine oil. This higher quality lubricant not only gives trouble-free operation, but it frequently reduces lubricant costs at the same time.





STANDARD STEAM CYLINDER OILS WILL HELP YOU MEET HEAVIER POWER DEMANDS

Higher steam pressures, maximum loads, or longer hours of operation—you have probably tried all known ways to meet the demands put on your power generating equipment. But, have you taken steps to prevent these emergency changes from eventually causing serious delays? Are you sure that the lubricants you are using will meet the new operating conditions? Will the cylinder oil give the necessary protection against increased wear? Let a Standard Lubrication Engineer answer these questions for you. He is working with other power plant men on these same problems. You can have the benefit of this experience at no cost to you. You may save many hours of maintenance time by spending part of an hour with one of these Engineers now.

SAVE TIME ON LUBRICATION PROBLEMS . . . ASK A STANDARD OIL ENGINEER FIRST

At the first sign of lubricating trouble, call in a Standard Lubrication Engineer. You'll save time by not having to experiment with various lubricants. You'll save maintenance by getting the answer to your problem sooner. You may even avoid that first sign of trouble if you call in one of these Engineers now and discuss your plant lubrication with him. Write the nearest Standard Oil Company (Indiana) office, or 910 S. Michigan Avenue, Chicago, Illinois. Ask for the Lubrication Engineer. In Nebraska, write the Standard Oil Company of Nebraska at Omaha.

BELMONT PACKINGS

Use the Belmont Packing Catalog to Solve Your Packing Problems

Save time.. GET RESULTS

...ted Asbestos

...ont 185—Spiral-Belmont 188

Coil-Belmont 189

...netration which is accelerated as the tem-

This braided asbestos packing is specially ...penetration and saturation are minimized. ...cold or hot, you can guard against seepage ...rial by installing Belmont Asbestos Packing ... and plungers. We particularly emphasize ...t service rendered when temperatures are at ...he packing is literally "boiled in oil".

...ON: Long fibre asbestos yarn, braided jacket ...ch strand treated with a special compound, ...ted and graphited. This packing is constructed ...pillary attraction and saturation. Supplied in ...sizes 1/8" and upward.

...ON: Cold and hot oil rods and plungers.

...nd Contents of Standard Sizes

...t Feet Per Spiral or Coil
Column C—Approximate Weight Per Box in Pounds

¼"			⅜"			½"			⅝"			¾"			1"		
B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
14	3½	1	14	4⅝	1	14	5⅝	1	14	6⅝									
31	8	1	24	8	1	22	10	1	19	10									

...data is given for estimating purposes only.

"6100" GASOLINE PACKING

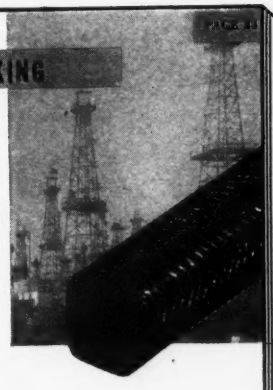
Spool-Belmont 6100—Coil-Belmont 6102

Ring-Belmont 6101

Belmont "6100" Packing is made especially for use on rods and valve stems handling distillates such as gasoline, naphtha, kerosene and benzol. Such solvents have a tendency to break down ordinary lubricants. This packing is lubricated under our own formula to retain softness and essential sealing qualities when applied against volatile distillates. It is particularly effective in that it eliminates the constant fire hazard of leaky stuffing boxes. The acceptance of Belmont "6100" by many of the largest oil refineries throughout the world is the best testimony of the superiority and safety of this packing.

CONSTRUCTION: High grade asbestos yarn, braided jacket over jacket, each strand of asbestos thoroughly impregnated with a compound especially prepared for use against oil, gasoline, naphtha, kerosene and benzol. Square cross section. Belmont 6100 is supplied in 1 lb., 3 lb. and 5 lb. spools in sizes 1/8" to 3/8" inclusive, securely boxed.
Belmont 6102 is supplied in flat boxes in sizes 7/16" and over. If desired, however, smaller sizes than 7/16" can be supplied in flat boxes under Belmont 6102.

APPLICATION: Piston rods and valve stems running in oil, gasoline, benzol, naphtha, kerosene.



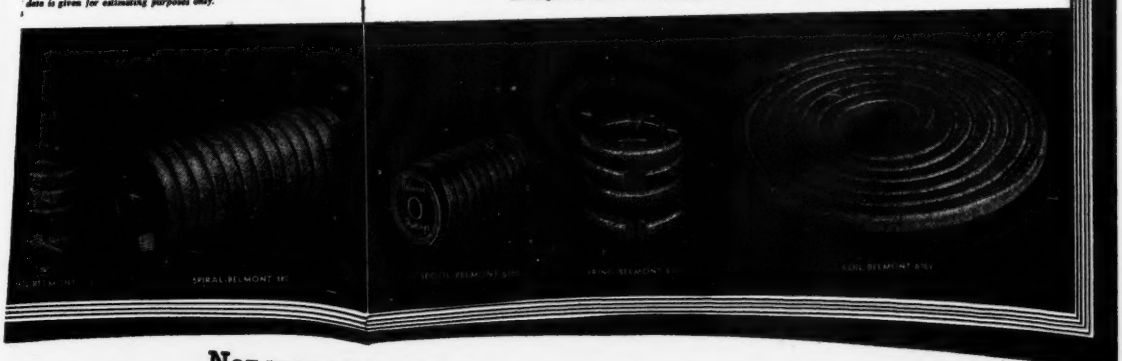
Note: For Rotary service against oil, gasoline, benzol, naphtha and kerosene, we recommend Belmont square braid (like Flax). Ring Form-Belmont 6105, Coil Form-Belmont 6106.

Table of Approximate Box Weights and Contents of Standard Sizes

Column A—Number of Spirals or Coils Per Box
Column B—Approximate Number of Feet Per Spiral or Coil
Column C—Approximate Weight Per Box in Pounds

Belmont Style	¼"			⅜"			½"			⅝"			¾"			⅞"			1"		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Coil 6102	1	121	5	1	54	5	1	66	8	1	37	8	1	23	8	1	26	10	1	21	10
Coil 6106	1	120	5	1	53	5	1	69	8	1	37	8	1	24	8	1	23	10	1	19	10

Box weights and contents are not guaranteed. This data is given for estimating purposes only.



NOT JUST ANOTHER CATALOG—but a packing reference book prepared by packing engineers. 84 pages of packing information, all reduced to its simplest form; with each and every type of Belmont packing clearly illustrated and described—as shown in the facsimile page above.

The Belmont Packing Catalog includes recommendation charts that enable you to check instantly, by type of service, Belmont's choice of packing styles (listed in the order of our selection). Packing end views are pictured in large size showing minute details. Construction, applications, tables of weights and measures are all laid out in easily readable form so that everything can be taken in at a glance.

The Belmont Packing Catalog is a time-saver, a book you should not be without. Write on your Company letterhead for your copy today.

There's a Belmont Packing for every service: Steam, Water, Oil, Gas, Air, Acid, Alkalis, Ammonia. Forms include: Rings, Coils, Spirals, Reels, Spools, Sheets, Gaskets. Whatever the need, Belmont has it.

Belmont Packings are Sold by Authorized Belmont Distributors in Every Large Industrial Center.

THE BELMONT PACKING & RUBBER CO.

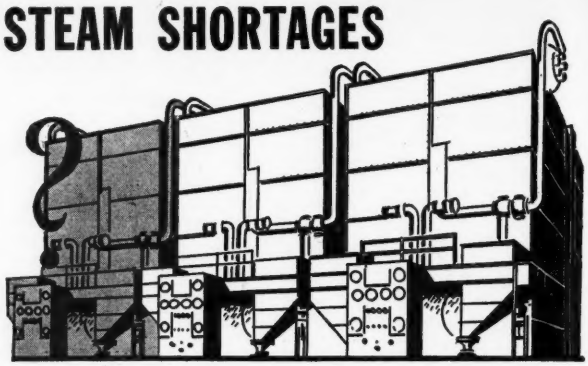
Dept. P.P. 442

Butler and Sepviva Streets • Philadelphia, Pa.

Shortages... and h

Shortages are *not* unavoidable . . . start remedying some of the causes!

STEAM SHORTAGES



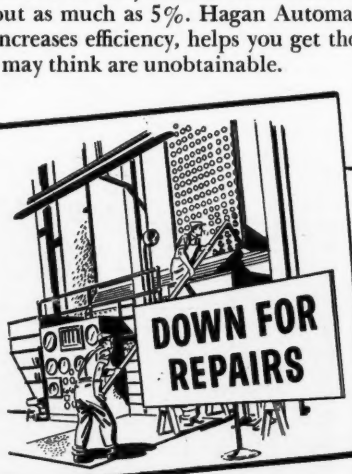
Lack of boiler capacity is not the only cause. Poor combustion can reduce steam output as much as 5%. Hagan Automatic Combustion Control increases efficiency, helps you get those vital *extra* pounds you may think are unobtainable.

TIME

You can get new boilers in a year or more—*maybe*. Hagan Control can be installed in a few months—all that is needed in many plants to get over peak production hurdles.

EQUIPMENT

By improving combustion efficiency, Hagan Control not only lowers stoker and furnace maintenance, but reduces boiler outages as a result.



MONEY

Steam production costs are rising and may go higher. You can depend upon Hagan Control to help you keep them at a minimum.

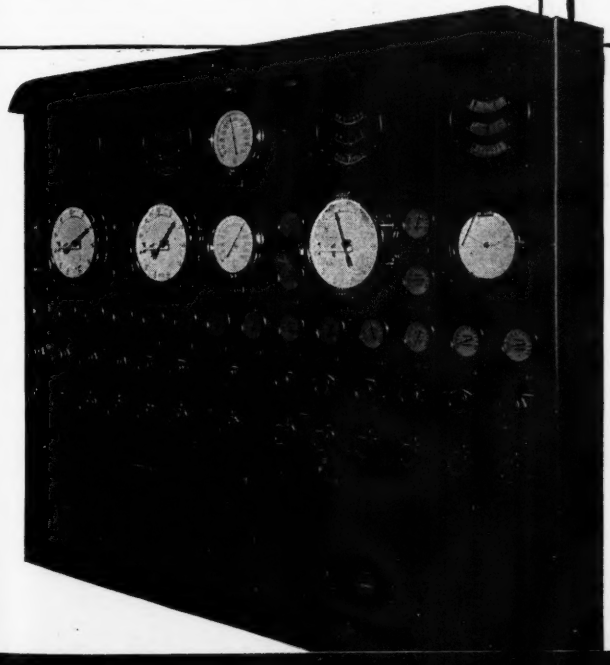
d how to help whip them

FUEL SHORTAGES

"Go easy on the gas" is a common warning today, but what about coal and oil? Fuel shortages can strangle production almost overnight. Savings of 3% to 6% are not unusual with *fully* automatic Hagan Control.

MAN POWER

Skilled operators are scarce. It takes time to train green replacements. By maintaining top efficiencies *automatically* and *continuously*, Hagan Control is particularly valuable during periods when your plant is temporarily undermanned.



Faced with any of these conditions, look into Hagan Automatic Combustion Control. A relatively simple, low-cost installation often is the remedy. We will gladly survey your needs without obligation. Write today—it is *worth* the effort.

. . .

Coal consumption *decreased 6.7% per k.w.h. by this installation of Hagan Automatic Combustion Control in a medium-sized power plant. Savings paid for the installation in less than a year.*

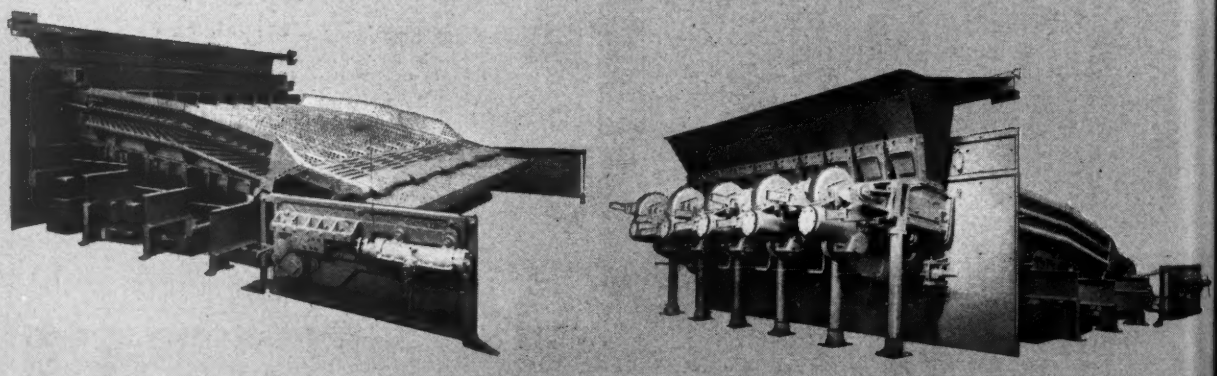
HAGAN CORPORATION
300 ROSS STREET
PITTSBURGH, PA.

HAGAN *Automatic* COMBUSTION CONTROL

The pioneer . . . and still the leader

★ ★ ★ STABILITY AND

DETROIT MULTIPLE (Ten) RETORT, INCLINED STOKER in a Public Utility Plant, designed to generate 90,000 pounds of steam per hour with Ohio Coal of 11,700 B. T. U.'s.



DETROIT STOKER COMPANY

Sales and Engineering Offices, General Motors Bldg., Detroit • Main Office and Works, Monroe, Mich.

D EFFICIENCY ARE IN-BUILT

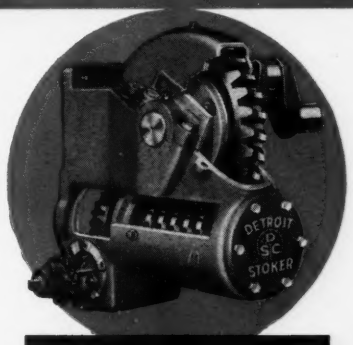
Investigate the outstanding Features:

- *Large square rams operate in ram cases with adjustable liners.*
- *Inclined retorts of decreasing depth with moving bottom plates.*
- *Coal feed adjustments with shearing pins separately for each retort.*
- *Extension moving rear grates.*
- *Dumping grates, simple operating mechanism, (Power or Manual) are accessibly located.*
- *High and low pressure air zones, with proper distribution.*

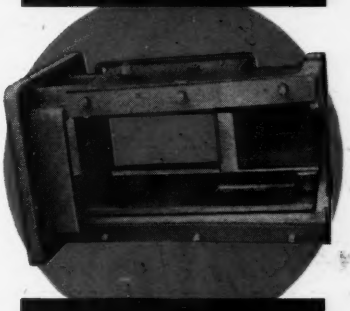
Ability of a Stoker to "take it" month in and month out without trouble—calls for *sound design* and *best construction.* Detroit Multiple Retort Stokers have this *Stability*—they are *Heavily Built* to withstand continual hard service.

Noted for high operating efficiency—here is typical performance:

Coals	B. T. U.'s Per Pound	Combined Efficiency of Boiler and Furnace
Kentucky	13,200	85.6%
Virginia	14,000	83.2%
Indiana	11,000	76.2%
Pennsylvania	13,900	80.5%
West Virginia	14,000	80.7%



MECHANICAL DRIVES—Machine cut worms and gears—tapered roller bearings—run in oil—dependable—require little power for operation.



RAM CASES—Renewable and adjustable liners assure correct fit of the coal plungers.

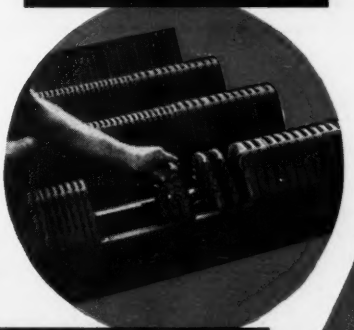
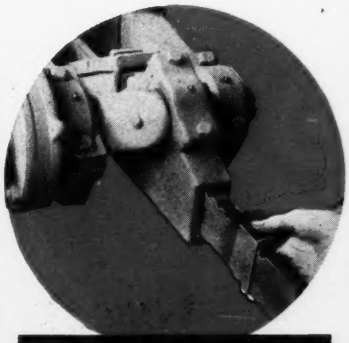


PLATE TUYERES—Are of high heat resisting iron, easily renewed.

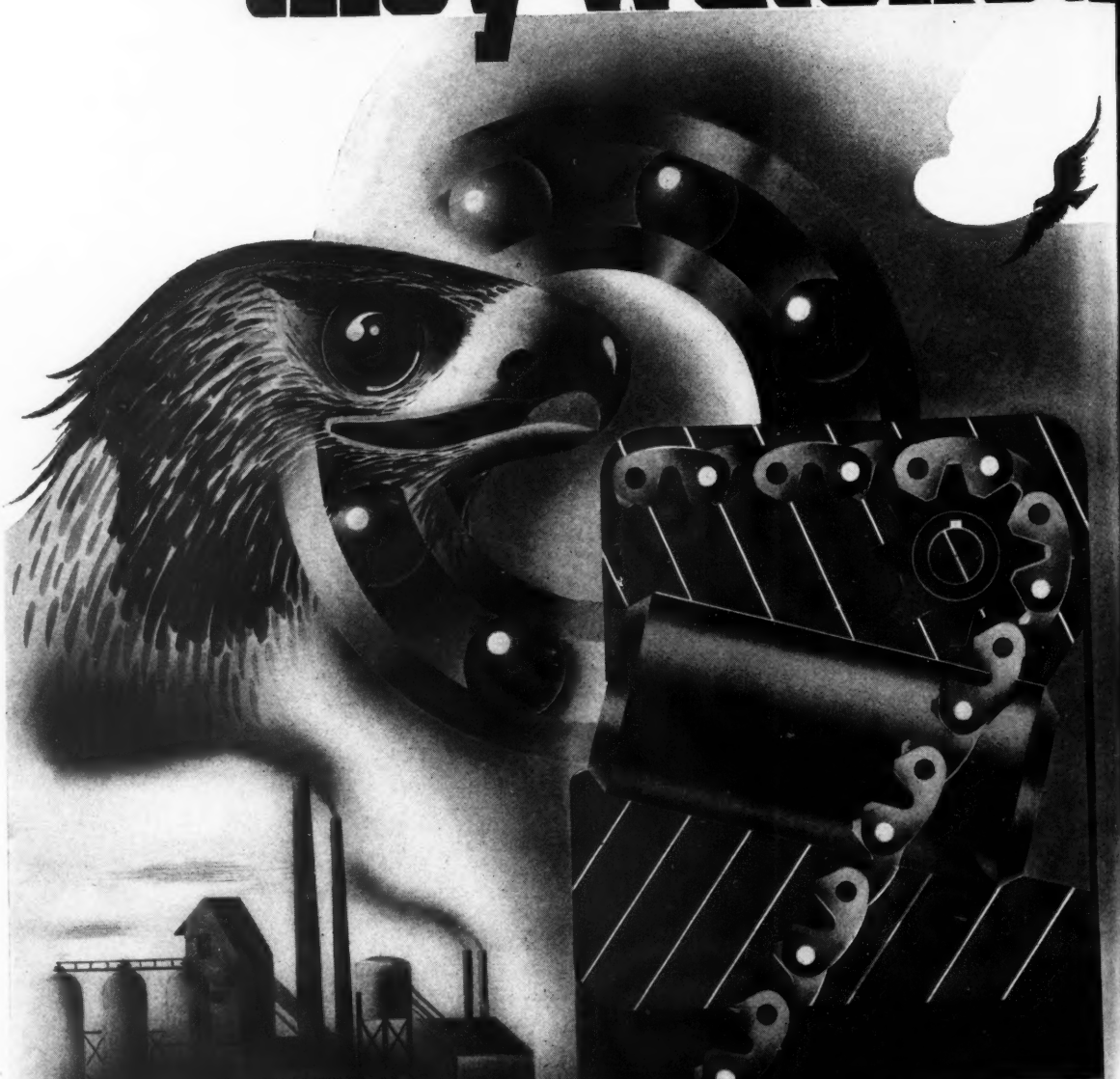
COAL DISTRIBUTION CONTROL—Moving retort bottoms control coal distribution—separately adjusted for each retort.



COAL FEED ADJUSTMENT—Readily made. Independent for each retort.

DETROIT MULTIPLE RETORT STOKERS

they watched



their bearings

"like a hawk"

until they switched to Tycol Green Cast Grease

This manufacturer had been experiencing numerous difficulties with the grease previously used on his centrifugal boiler pumps and the bearings on his chain stokers. On the advice of a Tide Water engineer they switched to Tycol Green Cast Grease. Since then the nuisance of having to keep an eagle eye on the grease job has been eliminated. Now they just put in Tycol Green Cast Grease and forget it. One less item to worry about — the grease stays put and does an economical and dependable job of lubricating.

Tycol Green Cast Grease can effect economies in your plant, too, because this modern grease is made from a paraffine base cylinder oil combined with a minimum of soap. More oil — less soap — means better lubrication.

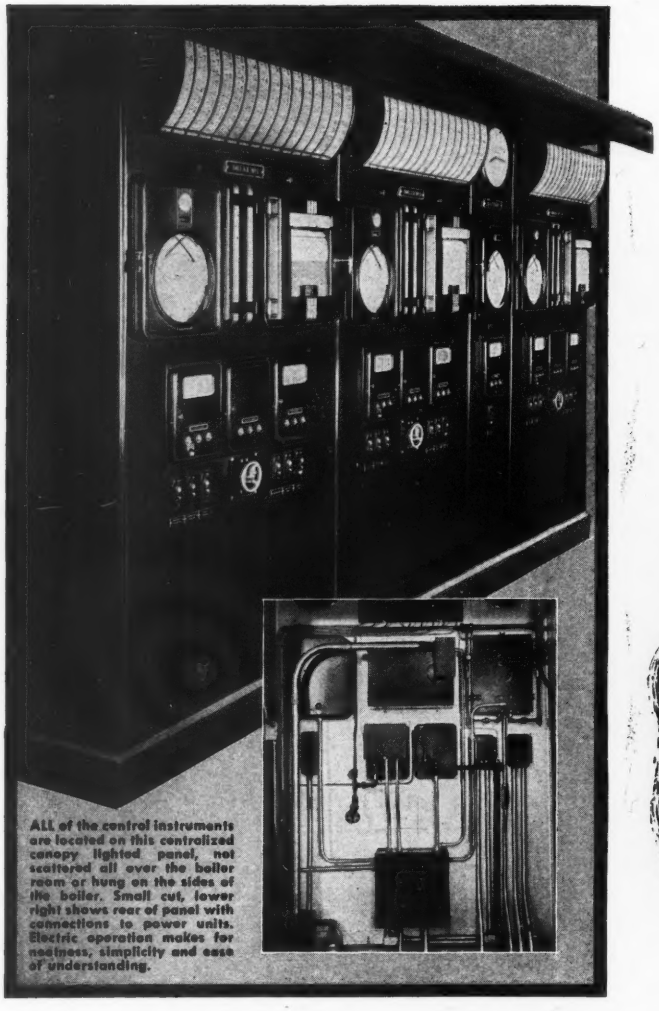
Let a Tide Water engineer show you where and how improved lubrication can step up production. Write the Tide Water Associated Oil Company, 17 Battery Place, New York, N. Y. Assistance is freely offered.

DRUMS! DRUMS! DRUMS! DRUMS!
War needs make it extremely important that all empty drums be returned immediately.

INDUSTRIAL TYCOL OILS-GREASES

TIDE WATER ASSOCIATED OIL COMPANY EASTERN DIVISION
17 Battery Place, New York
Regional Offices: Boston, Philadelphia, Pittsburgh, Charlotte, N. C.

MAKERS OF THE FAMOUS VEEDOL MOTOR OIL



ALL of the control instruments are located on this centralized canopy lighted panel, not scattered all over the boiler room or hung on the sides of the boiler. Small cut, lower right shows rear of panel with connections to power units. Electric operation makes for neatness, simplicity and ease of understanding.

Electric ALL THE WAY!

HAYS CENTRALIZED AUTOMATIC COMBUSTION CONTROL

Stokers, pulverizers, fans and oil burners are more and more becoming electrically driven. It is entirely logical therefore that an automatic combustion control system be operated electrically. Hays *centralized* control is operated entirely by electricity, employing enclosed mercury switches for the sensitive contacts, thus assuring freedom from trouble due to moisture, dust, dirt and chattering. Electric operation also simplifies installation and maintenance. Adjustments are made direct and are not dependent upon air pressures, oil pressures, and the numerous valve mechanisms made necessary by non-electric designs. When considering automatic combustion control buy for tomorrow—buy electric—buy **HAYS.**

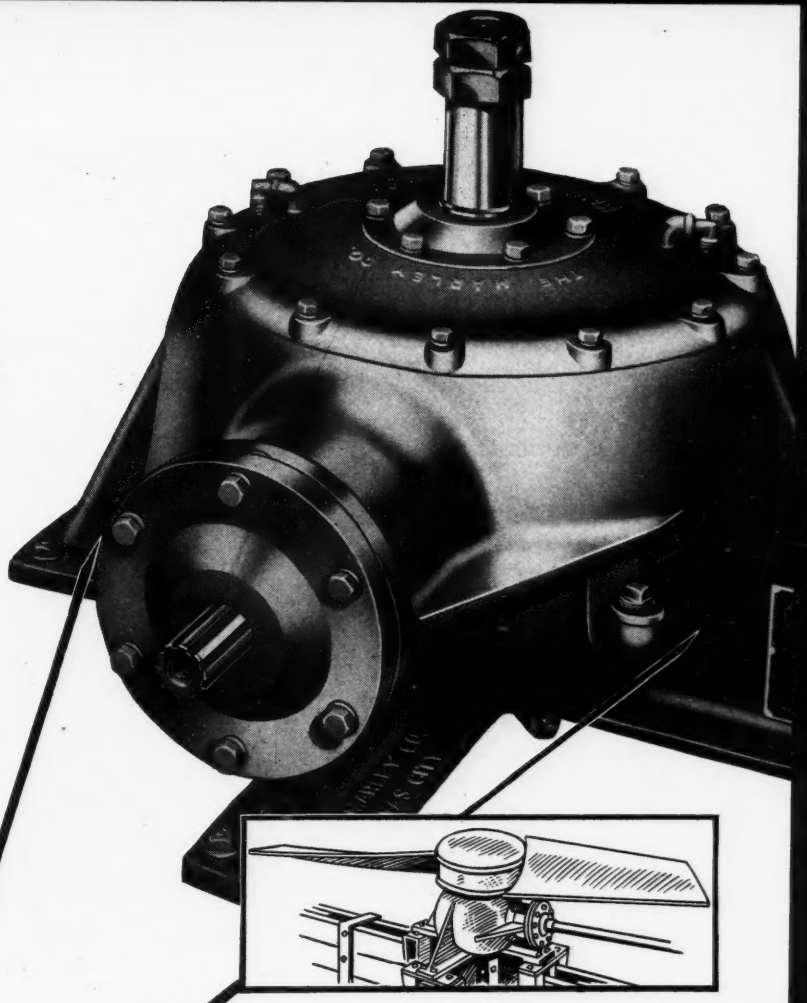
HAYS

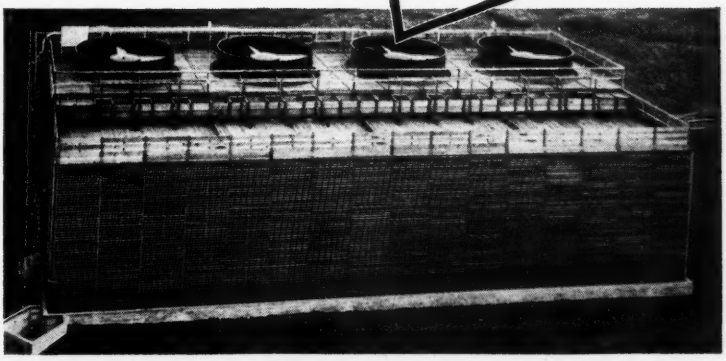
Automatic
COMBUSTION CONTROL
THE MODERN SYSTEM—*it's Electric!*

THE HAYS CORPORATION • • • MICHIGAN CITY, INDIANA

One of a series of advertisements, each devoted to a Marley cooling tower feature that has become an accepted standard of the best practice in modern mechanical draft water cooling.

Another of MARLEY'S PLUS Features





The *only* speed reducer designed specifically for cooling tower service, the Marley GEAREDUCER is produced solely by its originators, The Marley Company, to provide:

1. **Positive, direct drive for cooling tower fans from motors *outside* the air stream.**
2. **Unfailing operation in continuous service, without halt day and night, month after month.**
3. **Rugged dependability under punishing conditions of heat, dampness and heavy duty demands.**

The hundreds of GEAREDUCERS in service, many continuously throughout most of the past decade, are evidence of their success and acceptance. Positive lubrication, gears of "upset" forged moly-chrome steel, Timken tapered roller bearings, and rugged cast iron cases are but a few of their noteworthy features. Yet the GEAREDUCER is just one of many outstanding mechanical and structural details exclusive with Marley which, together, are the reason so many more cooling towers bear the Marley name than any other.

42A

MARLEY COOLING TOWERS

Every MARLEY TOWER *is individually engineered by* THE MARLEY CO., INC. — KANSAS CITY, KANSA

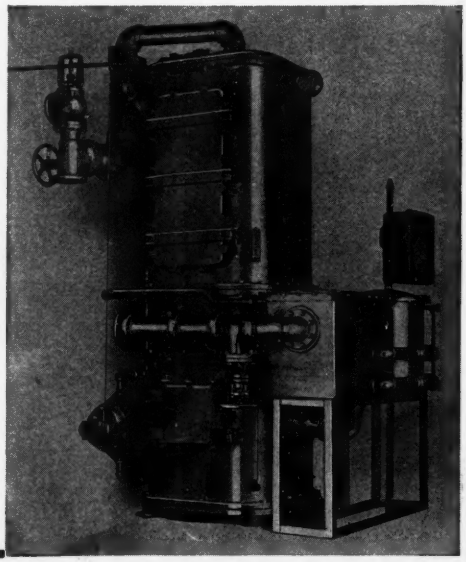
Swartwout Controls help you keep profitable power service flowing

with Safety Efficiency and Economy

KEEPING your power supply constant this next year means more than money to your Company; it means prestige, and satisfaction in knowing you've held up your end in the enormous job we're all doing. • Swartwout Equipment is serving steadily and safely in thousands of power plants—is available to you for more efficient control. Here is an unusual team of valves (left) designed by Swartwout—the single seated quick opening valve is located ahead of the spring loaded valve which reduces an initial pressure of 1850 lbs. to a final 400 lbs. • Swartwout has developed feed water regulation for a broad range of applications. The equipment example shows pilot-actuated feed water regulator with manual auxiliary control. • The combination Venturi Desuperheater and Atomizer has a capacity of from zero to 400,000 lbs. of steam per hour. • For assistance in solving problems of Feed Water Heating; Excess Pressure Regulation; Constant, Variable or Differential Pressure Control... make it a point to check with Swartwout.

The Swartwout Co., 18501 Euclid Ave., Cleveland, O.

SPECIAL 2500 LB. *standard quick opening bypass valve and high pressure reducing valve.*



IN CIRCLE: *Feed water regulation controls for 950 lb. pressure boiler — load fluctuating from 45,000 lbs. to 400,000 lbs. per hour.* **LEFT:** *Venturi Desuperheater and Atomizer.* **RIGHT:** *Swartwout Metering-Deaerating Heater built to rigid specifications, meets U. S. N. performance tests.*

Feed Water Regulators • Pump Governors • Feed Water Heaters
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•

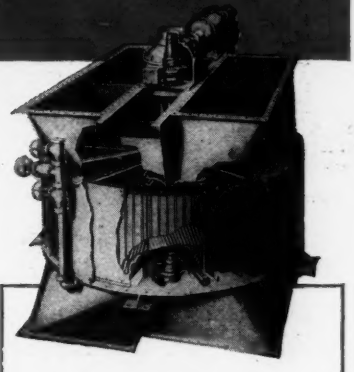
Another KIND OF AIR POWER

WITH A WARTIME JOB TO DO

In a wartime world where essential materials must be conserved to the limit, the use of preheated air for power plant combustion is no longer an auxiliary service. Rather, it is a key factor, accepted as essential by the designer of today's high-capacity steam generators. Many coals could hardly be pulverized without it; many high moisture fuels could not be burned efficiently without it. By improving combustion, it raises the unit capacity of furnaces. By increasing heat recovery, it conserves important quantities of fuel.

Among the several methods available for preheating combustion air, the economic balance ordinarily favors a Ljungstrom. But now the need for conserving steel adds an important new factor to the equation. Typically, a Ljungstrom Air Preheater weighs about *one-third* that of an alternate type meeting the same conditions. (In a specific case, 63,640 lb. as against over 200,000 lb.) To this direct saving, moreover, must be added the extra structural materials necessary to support the units in each case.

In recent months, every major builder of high-efficiency power plants has included Ljungstrom Air Preheaters in one or more jobs vital to America's war effort. In the coming months, we will do our utmost production-wise to carry forward the *conservation program* which the installation of every Ljungstrom Air Preheater sets in motion.



The *continuous regenerative counterflow* principle of the Ljungstrom Air Preheater accomplishes the maximum transfer of heat from flue gas to combustion air with the minimum of equipment weight and size. An informative bulletin explaining how this is accomplished will be sent on request. Just write:

THE

AIR PREHEATER

CORPORATION

Executive Offices: 60 East 42nd Street, New York, N. Y. • Plant: Wellsville, New York

27 years old... Original Rings

FULL POWER TOP STEAM ECONOMY

After 16 years, inspection of this 17x32½x11 Corliss finds tool marks still visible on cylinder walls, rings in perfect condition. It, too, has been 100% Texaco since the start.

In the 27 years that have elapsed since 1915, cylinders have never been opened. "Original rings are still steam-tight," says C. S. Read, Supt. of the Tuscaloosa, Ala., Water Works, where this 14 x30 x 10¼ engine pumps 2,700,000 gals. daily. Since installation, lubricants have been Texaco 100%.

WITH war needs putting every available power source on the line, steam engines old and new must be kept at peak.

Hundreds of engines like the two shown are giving maximum power per pound of steam, even after long years of service, because they are lubricated with *Texaco Steam Cylinder Oils.*

There is a *Texaco Steam Cylinder Oil* to meet every steam pressure and condition. These oils atomize completely, adhere to cylinder walls, separate rapidly from the exhaust.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred by steam engine operators everywhere.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distribution points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

FOR YOUR ENJOYMENT

FRED ALLEN every Sunday night. See your local newspaper for time and station.

TEXACO

TEXACO Lubricants and Fuels

FOR POWER PLANT EQUIPMENT

RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for War Needs.

ABP

ABC

POWER PLANT ENGINEERING

APRIL, 1942

VOLUME 46, No. 4

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Cover: The illustration shows the motor-driven roll and coiler of a cold reduction steel mill—one of the many power service applications in the booming steel industry. Photo, Carnegie-Illinois Steel Corp.

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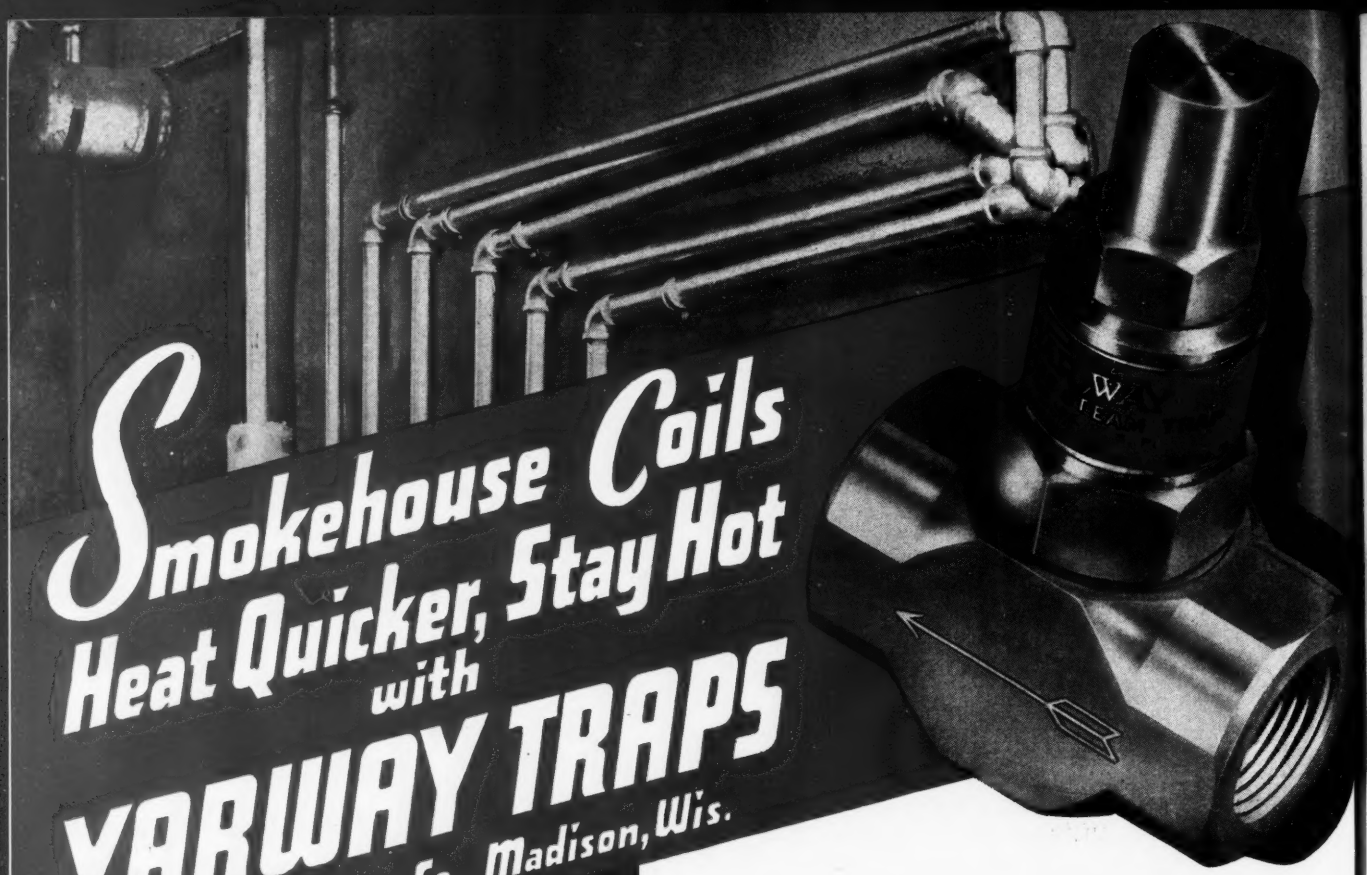
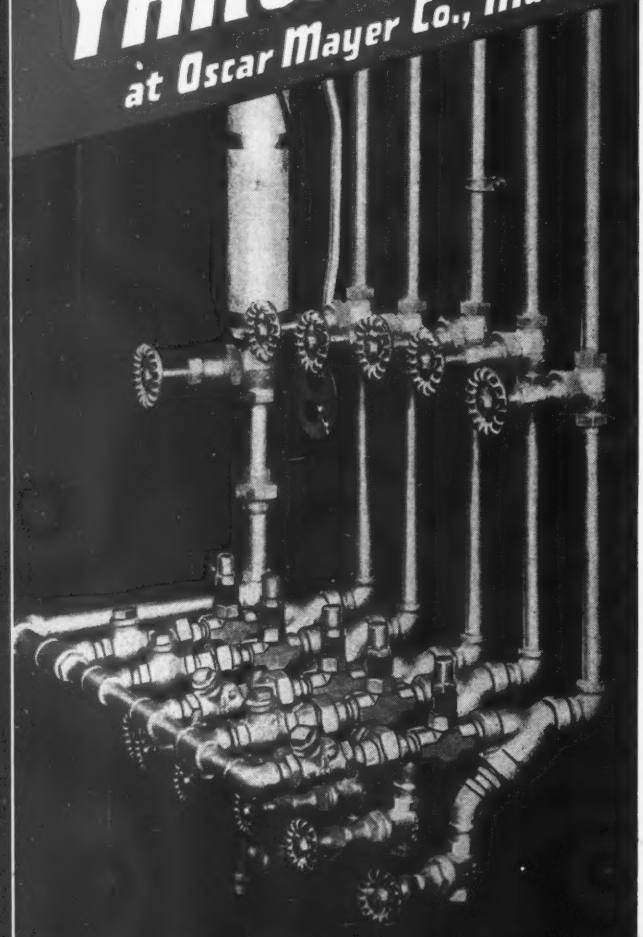


Smokehouse Coils Heat Quicker, Stay Hot with YARWAY TRAPS

at Oscar Mayer Co., Madison, Wis.



ILLUSTRATED is a five-bank smokehouse at the Oscar Mayer Co. plant, Madison, Wisconsin, showing each bank of tubes individually drained by a Yarway Impulse Trap.

The Yarway Impulse Trap's *continuous discharge on heavy condensate loads* during heating-up periods and its *intermittent operation on light condensate loads* have proven ideal for such smokehouse applications. Further, its *small size permits compact, efficient piping* arrangements that *save space, installation time and money.*

Have you investigated this steam trap that has solved many modern trap problems in the Food Processing Industry—that *saves time starting up* and *keeps equipment at top performance,* that *saves fuel, reduces maintenance* troubles and often *costs less to buy than to repair other traps?*

More than 130,000 Yarway Traps are already in service and sales are at an all-time high.

Ask your Mill Supply Dealer or write for Bulletin T-1736.

YARNALL-WARING COMPANY
114 Mermaid Ave., Philadelphia, Pa.

YARWAY IMPULSE STEAM TRAP

WHAT LEADERS SAY

The Railroads Can Take It—Anywhere

By JOHN J. PELLEY

RAILROADS of the United States in 1941 handled, without congestion or car shortage, the greatest volume of freight in their history. They are confident of their ability to meet transportation demands in 1942 if materials for adequate maintenance and for new construction are made available.

Despite unprecedented conditions, and the quickening effect of a growing defense and war production, traffic this year has moved smoothly and without delay. The railroads have performed an operating job of which they can well be proud.

Measured in revenue ton-miles (the number of tons of revenue freight multiplied by the distance carried), the freight volume transported in 1941 amounted to approximately 470 billion ton-miles. This was an increase of 5.1 per cent above the previous record made in 1929. It also was an increase of 25.9 per cent above 1940.

This record traffic took place despite the fact that carloadings of revenue freight were 20 per cent less than in 1929 and was due to a combination of heavier loading per car and longer haul per ton than in previous years. In 1941, freight loadings totaled 42,250,000 cars, an increase of 5,892,000 cars or 16.2 per cent above 1940.

This volume of freight traffic was handled, however, with an ownership of nearly 600,000, or 26 per cent, fewer cars, than in 1929. It was accomplished because of a continuous improvement in cars, locomotives, and facilities, and in operating methods and efficiency, that started 20 yr. ago and has kept growing despite the ups and downs of the railroads in more recent years. The result has been that the railroads in 1941 hauled more freight per train than ever before and moved each train over the road nearly 1½ times as fast compared with 20 yr. ago.

Among the outstanding efficiency records established by the railroads in the past year were the following, based on returns for the first 10 mo.:

1. Average load of freight per train was 915 t., a new all-time high and an increase of 40.6 per cent above that for 1921.

2. Performance per train hour more than doubled, gross ton-miles per freight train hour having increased from 16,555 in 1921 to 34,814 in 1941, while net ton-miles per freight train hour increased from 7,506 in 1921 to 14,977 in 1941.

3. For each pound of fuel used in freight service in 1941, railroads hauled 9.2 t. of freight and equipment one mile compared with 6.2 t. in 1921.

4. Average daily movement of locomotives was greater in 1941 than in any preceding year.

5. Average daily movement of freight cars established a new high record and exceeded 20 yr. ago by 45 per cent.

6. Capacity per freight car averaged 50.4 t., the greatest ever attained and an increase of 18.6 per cent compared with 1921.

7. Tractive power of locomotives averaged 51,495 lb., an increase of 39.4 per cent compared with 20 yr. ago.

Passenger traffic in 1941 was greater than in any year since 1929, it having amounted to 29 billion passenger miles (the number of passengers multiplied by the distance traveled), an increase of 22.1 per cent above 1940. This increase above last year was due in part to troop movements, the railroads having handled approximately three million troops during the year. The average revenue for carrying a passenger one mile during the past year was the lowest on record, amounting to 1.75 cents compared with 3.09 cents in 1921.

Railroads in 1941 installed about 80,000 new freight cars and about 600 new locomotives in service. They will enter the new year with approximately 75,000 new freight cars and 600 new locomotives on order with deliveries being constantly made. At the same time, both the number and percentage of freight cars now in need of repairs are less than ever before.

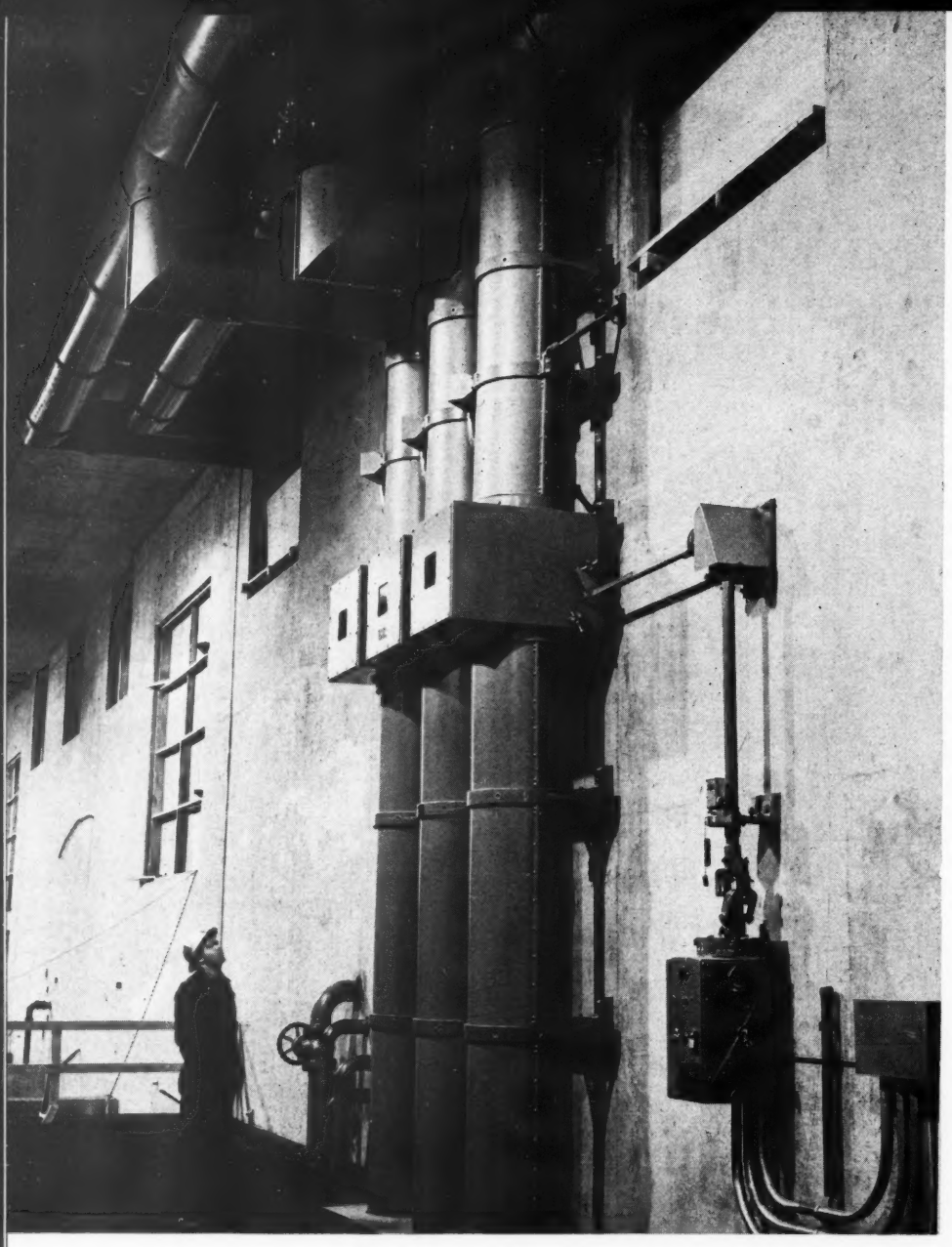
In order to furnish defense officials with information as to the extent to which car and locomotive building plants will be required to take care of the railroads' needs in the coming year, the rail lines, through the Association of American Railroads, in December resurveyed their equipment needs for the coming year.

As a result it has been determined that orders will be placed for the construction, in the year extending from October 1, 1941 to October 1, 1942, including those on order on the previous date 115,000 new freight cars and 974 new locomotives, including steam, electric and Diesel. In the opinion of railroad executives after a careful study of the general situation and railway performance in the past, this will increase their available motive power and car supply sufficiently to enable the rail lines to handle at least a ten per cent increase in traffic compared with 1941.

Stimulation in traffic during the past year has improved somewhat the financial position of the railroads. Whether this will continue to be true in the coming years remains uncertain owing to rising costs of operation.

Increased traffic as well as larger expenditures for maintenance work resulted in a further increase in employment on the railroads in 1941, the average number of employes having been 1,140,000, or an increase of 11 per cent compared with the preceding year. Average annual earnings per employe in 1941 was $2,018 compared with $1,913 in 1940.

JOHN J. PELLEY since 1934 has been president of the Association of American Railroads, the organization of the principal railroads of the United States, Canada and Mexico for dealing with matters of common concern in railroad operation, maintenance, engineering, research, traffic, accounting and finance, valuation, taxation, law and legislation, economics and public relations. ¶ From a track apprenticeship on the Illinois Central Railroad in his native Illinois, Mr. Pelley climbed steadily upward, reaching the office of vice president in charge of the system's operations in 1924. In 1926, he became president of the Central of Georgia Railway and the Ocean Steamship Co., both affiliated with the Illinois Central System. ¶ In 1929, Mr. Pelley became president of the New York, New Haven & Hartford Railroad Co. and remained in that position until 1934 when he was elected president of the Association of American Railroads—formed in that year.



138,000 Volts Enclosed

IN THIS AGE of streamlining even electrical conductors take on strange appearances. These curious looking, square cornered pipes look as though they might be designed to carry liquids of some sort, and in one sense they do because they carry part of the Columbia River but, actually, they are the housed-in, 3-phase generator connections which transmit the power from the generators to the transformers outside. The 108,000-kw. generators at Grand Coulee generate power at 13,800 v. At this voltage it is transmitted through these enclosed buses to the transformers where the energy is stepped up to 230,000 v. for distribution to aluminum plants and other important industries on the west coast in the manufacture of weapons for victory. This photograph shows the connections for one generator. At present two of the nine 108,000-kw. units are in operation

WITH THE EDITORS

◆ **WE PAUSE** . . . At this time when war news from the Pacific makes everything but industrial conversion seem relatively unimportant, we pause to consider a term synonymous with Americanism—Free Enterprise. At a recent meeting of business paper editors, Donald Nelson pointed out what so many Americans have overlooked. There are two words in the phrase and one of them is "enterprise."

Production of implements of war is running 75 per cent of what it should for one very simple reason. Too many manufacturers, proud of having built up a business in the fiercest kind of competition, feel that conversion of their plants to war purposes is a job for the WPB, that the world having whipped up a war to rob them of regular business is obligated to keep their plants running by providing war business on a silver platter.

◆ **A SAD MISTAKE** . . . Nothing is farther from the truth. Plants whose managers wait for the WPB to figure out and assign them jobs will still be waiting when the war is over. No Washington bureaucrat, not even the industrial super-experts of WPB, can figure out a job for each of the 184,000 industrial plants in the country. Time and physical limitations make it necessary for them to concentrate on the larger and more essential plants and parts, thus throwing the smaller companies entirely on their own responsibility.

Conversion is a job demanding all the ingenuity, determination and initiative of the component parts of each individual plant. There is more than enough business to go around, but each plant organization must figure out what it can make, make it better than ever before, and, finally sell it to the government or some prime contractor. Dozens of small plants have been successful in doing this and it is imperative that thousands of others follow their example.

And that's not all—the change must be made with equipment now available—no waiting 3, 6 or 12 mo. for WPB to round up a lot of special machines. Conversion was once a high sounding name for a new factory with a lot of fancy machines—now it's simply doing the best you can with what you have.

◆ **POWER, TOO** . . . Conversion in the power industry? Decidedly and it's the same old story of doing the best you can with what you have. Standby capacity will be dug out of moth balls, reserve capacity pulled down, and off peak loads built up.

WPB's huge expansion of aluminum and magnesium plants, with 150,000,000 lb. aluminum plants in New York, Philadelphia and Boston (or Hartford) is based on a power policy of building up firm loads on utility systems up to the full name plate ratings including normal reserve.

Standby capacity equal to the largest unit in operation is too great a luxury for war conditions. Designated industrial, and perhaps even domestic load, blocks will be used for the same purpose as standby and tripped out on breakdown. The aluminum plants are ideal for the purpose because the plants can be built where power capacity is availlable in a short time, and, when built, the aluminum pots can be tripped off without damage or serious interference in operations.

◆ **A FALSE RUMOR** . . . While considerable utility capacity scheduled for 1942 may be deferred, there is no truth in the persistent rumor current for some time that all turbine manufacturing facilities would be devoted exclusively to Navy work. A recent inquiry to Washington authorities brought the following reply:

"There is no truth in any report that all deliveries of generating equipment scheduled for 1942 private power companies have been canceled and the entire manufacturing facilities devoted to the Navy. It is true that heavy Navy demands are compelling deferment to 1943 of delivery of some generating equipment scheduled for delivery this year. However, substantial amounts of new generating equipment in both steam and hydro scheduled for delivery this year will be delivered on time and will be added to the nation's power facilities before the end of this year."

◆ **CONVERSION IN STEPS** . . . In England, after Dunkirk shattered all possibility of "Business as Usual", conversion proceeded in three steps. First, skimming the cream of industry by immediately swinging into war production plants that could be converted with a minimum of retooling. Second, limiting consumer goods in order to reduce transportation demands, conserve raw material and release men and machines for more essential service.

Third, introduction of the nucleus system whereby only the most efficient plant of an industry was retained in service, but with its output split with the others and trade names and personal contacts retained. In this country we are still on the first step, with some consideration being given to the second and third phase in an informal sort of way.

◆ **MAE WESTS** . . . Oddly enough one of the first units put into active war service were the rubber and silk stocking industries. They turned out the barrage balloons, the famous "Mae Wests." These supported London staunchly during the air raid period. Sir Clive Baillien, director general of the British Raw Material Mission and British representative on the Allied Joint Raw Materials Board is authority for the statement that this support was literal as well as figurative. For verification he quotes an Australian, who disgusted by months of inaction in the fog of London, caustically inquired, "Why don't they cut the ropes and let the darn place sink?"

◆ **LABOR AND MIGRATION** . . . Again on the serious side—by the end of 1941 a quarter of the entire civilian population of England had been shifted to war work, this exclusive of the millions engaged in this work before the final drastic steps were taken. More than a million women who did not work in peace time were working in ammunition factories and one-fifth of the entire population were forced to leave home and families because they were needed elsewhere.

◆ **FIGHTING WITH DOLLAR BILLS** . . . Money is advisable in time of war or peace, but the vital period of effective economic warfare is past. Appropriations of millions and billions for war purposes are impressive, but we can't lick the enemy by throwing dollar bills at them.

These dollars have meaning only as a measure of the job ahead. When they have been changed into effective weapons and the enemy beaten to its knees we can again relax and contemplate our untold potential resources. Right now there is no time or place for anything but action, conversion of facilities to war work and production. This is a job for individuals, not superboards, or whole industries, but individuals. Big shots are important in the initial stages, but it's the little fellow who does the work. These little fellows are not always overly careful. Last year almost half a billion man days were lost from accidents. Every accident is a boost for the Japs.

LOW COST MODERNIZATION Sought in Moline Plant Expansion

High-pressure bleeder turbine and stoker fired integral furnace boilers provide low cost modernization for old electrical generating equipment in Moline Plant. Load characteristics and other plant considerations dictate use of stokers in preference to pulverized fuel equipment

By E. H. THROCKMORTON
The United Light & Power Service Co.
Davenport, Iowa

ANALYSIS of load conditions in the Tri-City area, which is served by the Iowa-Illinois Gas & Elec. Co's. Riverside and Moline steam plants, showed conclusively in 1939 that additional generating capacity was needed to meet the system peak load. The analysis also indicated that the new capacity should be installed in the low-pressure Moline plant where it could serve as a topping unit, replace the inefficient low-pressure boilers, and, improve the station efficiency as well as capacity.

Prior to 1940 the Moline station contained four condensing units with a total capacity of 35,300 kw. of which the last 16,000 kw. was installed in 1918. Since 1925, when the first 20,000-kw. unit was placed in service at Riverside, the Moline units have been used for peak load and emergency service only. All units were supplied with steam at 190 lb. ga. and 540 deg. F. total temperature from forced draft underfeed, and natural draft chain grate, fired, brick set boilers without heat recovery equipment.

The addition at the Moline plant comprised: two boilers each suitable for 100,000 lb. steam capacity at 825 lb. ga. pressure complete with auxiliaries installed in 1940; and, one 15,000-kw. non-automatic bleeder and condensing turbo-generator complete with auxiliaries, installed in 1941. The boilers were installed in two of three open spaces available in the 1917 boiler house. Orders have been placed for a third boiler to be installed in 1943 in the third space.

In order to provide space in the existing turbine room where facilities were available for condensing water, it was necessary to remove a 2400-kw. turbo-generator, which had seen more than 30 yr. service, and to lower the basement floor some 8 ft. to make a satisfactory installation.

The new boiler installation comprised a modified B. & W. integral furnace boiler with economizer and regenerative air heater. The latter were proportioned to give 325 deg. F. exit gas temperature and a preheated air temperature of 300 deg. F., considered conservative for the fuel which was to be burned.

Previous experiences with spreader stokers in other plants of the company indicated that this type of fuel burning equipment would adequately meet the standby and peak load requirements of the Moline plant for the following reasons: 1, A wide fuel burning range of from 0 to 60 lb. of coal per sq. ft. of grate area; 2, good combustion of fuel; 3, rapid response to change in load; 4, a ready demand for stoker ash; 5, comparatively low initial cost; 6, ability to burn ⅜-in. and under screenings which are available at lower cost than 1¼-in. screenings; and 7, low maintenance cost.

Most important of the features of the spreader stoker for this installation was its ability to operate for extended periods at light loads without loss of ignition, and at a reasonable efficiency, and, then pick up full load on standby service under automatic combustion control.

Coal is supplied to the spreader stoker from an overhead bunker to an extension hopper with a 7 t. capacity. Ash is removed from each of the five sections of the furnace by means of a power dump grate to five, two-compartment steel

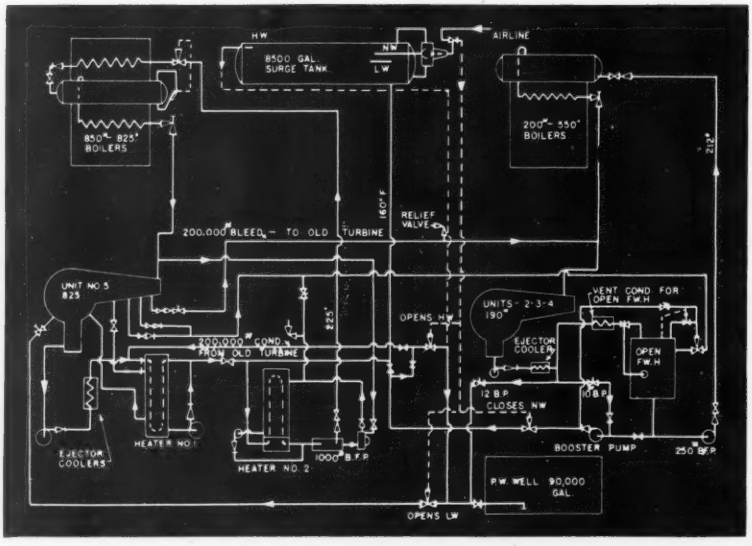


Fig. 1. Flow diagram of the station showing the steam and condensate flow between the new high-pressure and old low-pressure units. Evaporated make-up is supplied by the low-pressure boilers during peak periods and stored in the pure water well. The condensate flow between units is divided, and make-up to the high-pressure unit is controlled, by means of the three pilot air operated valves actuated from the water level in the surge tank

hoppers with water sealed gates. Ash can be removed from each of the steel hoppers without interfering with the forced draft air supply to the stoker.

Combustion is automatically controlled by means of a master control actuated from steam pressure. The control increases or decreases the fuel and air supply which are tied together mechanically with a hand adjustment to care for variation in fuel. A fixed furnace draft is automatically maintained by a draft regulator which adjusts the uptake damper. The speed of induced draft fan is automatically controlled by a differential regulator which maintains a fixed pressure drop across the uptake damper by adjusting the speed of the hydraulic coupling. A timing interrupter is used in the hydraulic coupling oil pump control circuit to prevent hunting.

The 15,000-kw. single flow single cylinder turbine was arranged for extraction of 200,000 lb. steam at 215 lb. ga. and 550 deg. F., and, for two stages of feedwater heating. The turbine exhausts to a two pass surface condenser with 13,200 sq. ft. cooling surface, sufficient to maintain, with 70 deg. F. cooling water, 1.5 in. abs. back pressure on the turbine when operating on the feedwater heating cycle and carrying 17,000 kw. load.

In this station the feedwater heating problem involved the heating of not only the condensate from the new turbine but also that from the old units which are supplied by steam extracted from the new turbine. The feedwater heating cycle for the new installation is shown in Fig. 1. The first stage closed heater was designed to heat 300,000 lb. of condensate from condenser temperature to approximately 160 deg. F. by 6 lb. abs. steam extracted from the first bleed point of the turbine. Steam is extracted from the second and third bleed points of the turbine, at from 18 to 28 lb. abs. pressure depending upon the load to supply the old open feedwater heater when it is necessary to operate the 200 lb. boiler equipment to carry loads in excess of the capacity of the two 825 lb. boilers.

The second stage closed heater serves as a condenser for the exhaust steam from the boiler feedpump turbines. Excess steam required to heat feedwater to 225 deg. F. is supplied through a reducing valve from the second and third bleed points on turbine.

Turbine drives were selected for the boiler feedpumps in order to provide a variable speed drive which would be inexpensive and at the same time be capable of a wide speed range so that the pumps could be operated at either 300 or 1000 lb. pressure.

A special differential pressure regulator, operated from the boiler drum pressure and the pump discharge pressure, was installed on the boiler feedpump turbine and arranged to act on the main turbine speed governor to control the turbine speed and pump pressure. Figure 2 shows the performance curves for the boiler feedpump with constant and variable speed drives.

Under variable speed performance with the pump pressure following the system head curve, the power input to pump is approximately 30 per cent less at 200 g.p.m. capacity than that required for constant speed operation and throttling the excess pump pressure in the boiler feedwater level regulator. With pumps having a steeper head curve the per cent reduction in power will be greater than 30 per cent.

Condensate is used exclusively in the 825 lb. system to prevent scale in boilers and water wall tubes. Make-up is evaporated in the 200 lb. boilers and condensed in the condensers of the 200 lb. turbines during peak load periods. It is stored in the pure water well for use in the 825 lb. boilers during off peak periods. Water is automatically divided between the 200 lb. and 800 lb. system by means of pilot operated valves controlled from the level of the water in the surge tank.

It was considered desirable to have new auxiliary motors suitable for 440 v. 3-ph. current. This made a new source of auxiliary power necessary as the existing house circuits were 440 v., 2-ph., 4-wire. Duplicate transformers were installed, each with a rating of 1250 kv-a., 4800 v. (2 ph.)/440 v. (3 ph.). The secondaries of the transformers feed a metal enclosed drawout type breaker structure, which contains electrically operated air circuit breakers for transformers and motor circuits.

Significant features of the Moline Plant extension program in brief:

1. Selection of 825 lb. steam generating equipment which could be initially operated at full capacity at 200 lb. pressure to provide economical 200 lb. steam to supply the existing turbines.

2. Use of integral furnace boiler and spreader stokers to permit installation of steam generating equipment in space available in the existing boiler room where the height was limited.

3. Use of spreader stokers, instead of a more expensive powdered coal system which was less adaptable to peak load and spinning reserve operation, to contribute to the reliability of operation.

4. Use of a bleeder type turbine to permit extraction of steam for operating old turbines when station load is in excess of 8000 kw., and to provide spinning reserve when required, with relatively high economy.

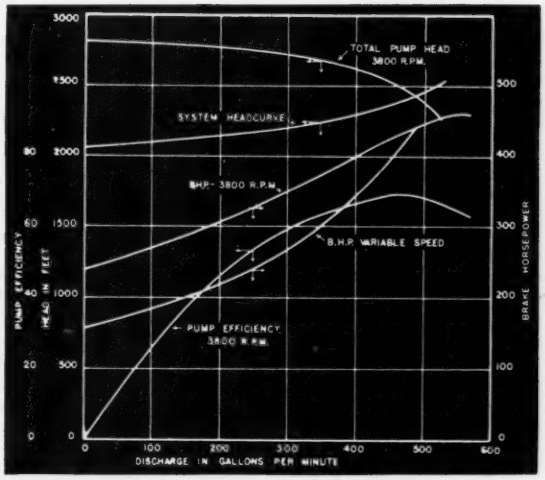


Fig. 2. System head curve and boiler feedpump characteristics showing the savings in power of variable speed over constant speed pump operation. The boiler feedpump turbine exhausts to the No. 2 closed heater as shown by Fig. 1

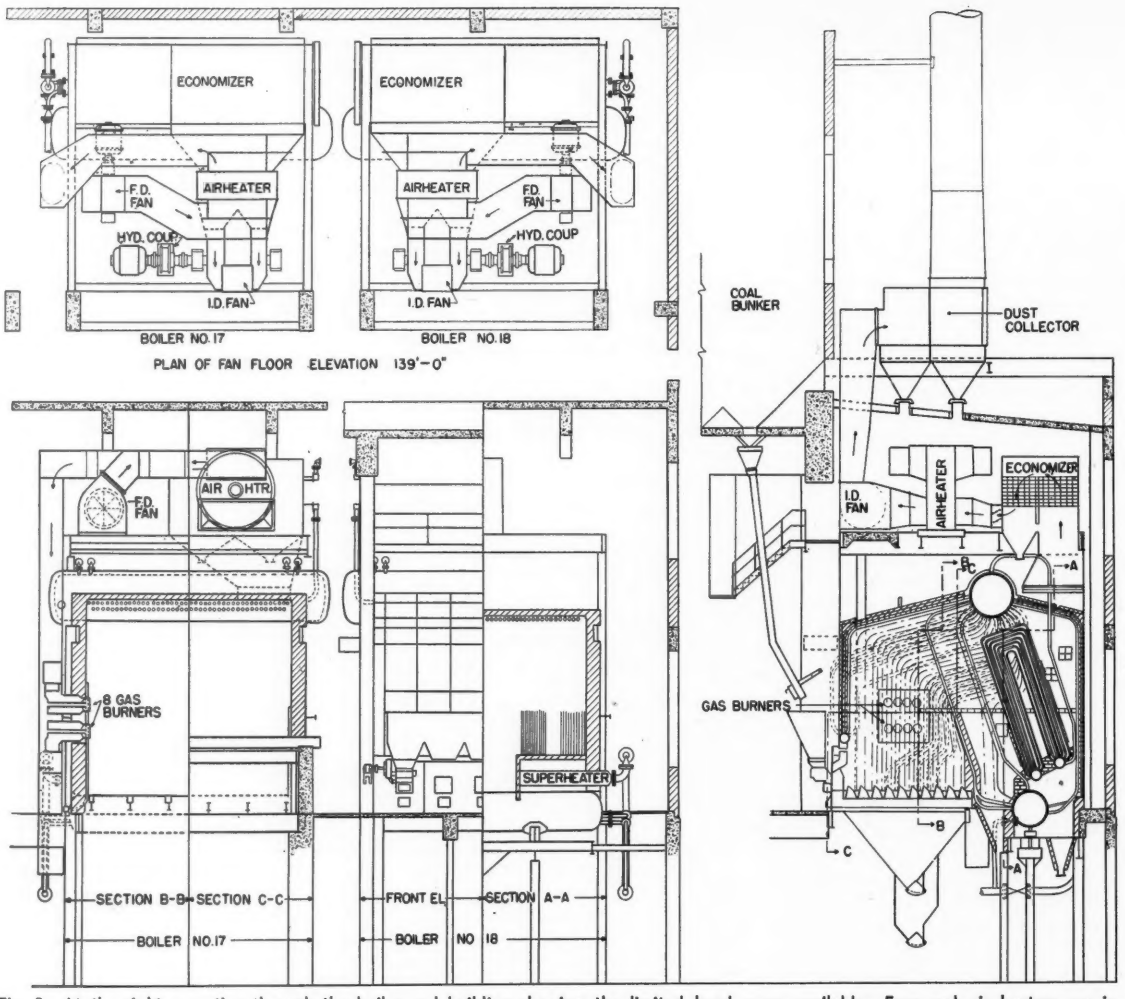


Fig. 3. At the right a section through the boiler and building showing the limited head room available. Fans and air heaters are installed above the boiler and the dust collectors on the roof. At the left (above) plans of the fan floor, and (below) elevations of the boiler front and three sections through the furnace

LIST OF PRINCIPAL EQUIPMENT IN THE MOLINE PLANT EXTENSION

Boilers—Two Type E integral furnace boilers for 100,000 lb. per hr. evaporation with feedwater at 225 deg. F. Design pressure 900 lb. per sq. in. in drum, operating condition, 845 lb., 825 deg. F. at the superheater outlet. The Babcock & Wilcox Co.

Superheaters—Two 4-pass, six loop convection superheaters with 3000 sq. ft. of heating surface. The Babcock & Wilcox Co.

Economizers—Two pass counter flow bare tube economizers with 2345 sq. ft. of heating surface. The Babcock & Wilcox Co.

Air preheaters—Two Ljungstrom regenerative type Size 14 air heaters with 5785 sq. ft. of heating surface. The Air Preheater Corp.

Induced draft fan—Two Sirocco, Size 6½, ⅔ double width fans, capacity 75,000 c.f.m. at 13¼ in. of water. Drive 250 hp., 440 v., 3 ph. 1,180 r.p.m. induction motors with 24 in. Class 5 hydraulic coupling with reversible motor driven oil pump. The American Blower Corp.

Forced draft fan—Two American high speed, Size 5½, double inlet, Class 4 fans with vane control, capacity 43,000 c.f.m. at 9.25 in. of water. Drive 100 hp., 440 v., 3 ph., 1,765 r.p.m. induction motors. The American Blower Corp.

Dust collectors—Two tubular centrifugal type dust collectors with 6-in. tubes. The Prat-Daniel Corp.

Dust handling equipment — Blower driven ejectors from collector hoppers to furnace where dust is melted. Blowers by the American Blower Corp. Ejectors by the Hoffman Combustion Eng. Co.

Ash handling equipment—Hoppers and roll crushers, hydraulic sluice, and Hydroseal pump to storage. The Allen-Sherman-Hoff Co.

Stokers—Two Hoffman Firite stokers with 290 sq. ft. of grate area. Maximum continuous fuel capacity 15,000 lb. per hr. The Hoffman Combustion Engineering Co.

Turbine — One single-cylinder single-flow non-automatic bleeder, condensing turbine, designed for 825 lb. ga. 825 deg. F., 1 in. abs. B.P. and 200,000 lb. steam bled at 215 lb. ga. Generator 15,000 kw. 0.7 p.f. 3600 r.p.m., 13,800 v., 3-ph., 60 cy. air cooled without exciter. The General Electric Co.

Condenser—One 13,200 sq. ft. 2-pass divided water box, condenser with ⅞-in. tubes, 20 ft. long and suitable for 1½-in. vacuum with 14,900 g.p.m. of 70 deg. F. water. The C. H. Wheeler Mfg. Co.

Feedwater heaters—Two closed heaters each with a capacity to heat 300,000 lb. water per hr. The Ross Heater and Mfg. Co.

Boiler feedpumps—Two Type 3 HMT horizontally split 8-stage Cameron boiler feedpumps for 450 g.p.m. at 2500 ft. head by the Ingersoll-Rand Co. Drive: Two 450-hp. back-pressure turbines 825 lb. ga., 825 deg. F. at throttle, 10 lb. B.P., 3800 r.p.m. Terry Steam Turbine Co.

Piping and valves—By Crane Co., Midwest Co., Geo. B. Limbert Co.

P.R.V. and desuperheating station—Capacity, 200,000 lb. per hr. The Swartwout Co.

Feedwater regulators — Two element. The Swartwout Co.

Combustion control—Arranged by company's engineers, equipment by A. W. Cash Co.

Electrical equipment—Transformers by Allis-Chalmers Mfg. Co. Drawout type breakers. The I.T.E. Circuit Breaker Co.

Pilot operated water control valves—The Fisher Governor Co.

Morrell Boiler Tests

Acceptance tests made with 9500 B.t.u. Iowa coal shows an efficiency of 85.31 per cent over a 7 hr. period at rated capacity

LATE in 1941 John Morrell & Co., meat packers, installed a new 100,000 lb. per hr., 400 lb. pressure boiler in the Ottumwa, Ia., plant.[1] Acceptance test results, summarized in Table I, show an efficiency of the complete unit of 85.31 per cent when burning Iowa coal at rated capacity.

The boiler, designed for a continuous output of 100,000 lb. per hr., is a B. & W. four drum, Stirling, Class 42, No. 30, with: 9480 sq. ft. of boiler heating surface; 3052 sq. ft. of bare water wall surface; 2867 sq. ft. of convection superheater surface; 17,920 sq. ft. of tubular air heater surface; and, a furnace volume of 9296 cu. ft.

Provision is made to burn oil or gas as supplementary fuels, but the unit was designed primarily for the use of pulverized, high volatile Iowa coal, provided by two B. & W., Type E, Size 35, Class 221BA pulverizers. Other auxiliaries include Clarage forced and induced draft fans, both dual driven: Worthington-Moore steam turbines driving through a Cutler-Hammer magnetic clutch on one side; and, synchronous motors driving through an E-M variable speed magnetic drive on the other. The unit has a Prat-Daniel Multicyclone dust collector and is controlled automatically by a Hays electrically operated combustion control system.

During the test the actual evaporation averaged 95,237 lb. per hr. at a pressure of 402 lb. ga. and 681 deg. F. at the superheater outlet (superheater pressure drop 15 lb. per sq. in.). While the actual evaporation was somewhat below rated capacity, the heat absorption, due to the low feedwater temperature of 150.3 deg. F., was materially higher than the guaranteed figure based on 212 deg. F. feedwater.

Coal burned amounted to 14,572 lb. per hr. with a heat value as fired of 9447.5 B.t.u. per lb., giving an average heat release of 15,437 B.t.u. per cu. ft. of furnace volume. The proximate analysis in per cent was: Volatile matter, 32.80; fixed carbon, 34.60; moisture, 15.70; and ash, 16.90. The ultimate analysis, also in per cent, was: C, 51.52; H, 3.54; O, 6.07; N, 1.09; S, 5.18; ash, 16.90; and moisture, 15.70.

Pulverizer power consumption averaged 15 kw. per ton of coal with the following average figures for the two mills: through 60 mesh, 98 per cent on both mills; through 100 mesh, 92 and 95 per cent; through 200 mesh, 81 and 84.5 per cent. Refuse collected amounted to 17.75 per cent of the fuel as fired (919 lb. per hr. from the ash pit and 1675 lb. per hr. from the stack). Combustible in the flyash averaged 8.55 per cent.

Gases (flow averaging 143,370 lb. per hr.) left the boiler at 598 deg. F. and the air heater at 355 deg. F. Air entered the air heater at 110 deg. F. and left at 516 deg. F. Gas analyses in per cent were: at the boiler outlet, CO_2, 14.0, O_2, 4.7, CO, 0.0 and N_2, 81.3; at the air heater outlet, CO_2, 13.9, O_2, 4.4, CO, 0.0 and N_2, 81.7. On an as fired basis per pound of fuel, dry gas flows were calculated as 9.674 lb. at the boiler outlet and 9.738 lb. at the air heater outlet, with 9.355 lb. of air supplied for combustion.

The total draft loss of 5.25 in. of water was divided 1.07 in. through the boiler and 4.19 in. through the air heater with an additional loss of 1.5 in. in the dust collector. On the air side the total pressure loss of 7.11 in. was divided: 2.06 in. in the windbox and 5.05 in. in the air heater and ducts.

[1] See Morrell Plant Burns Three Kinds of Fuel by Dan S. Helmick and Ellwood L. Johnson, Power Plant Engineering, page 48, January, 1942.

Table I. Heat balance as calculated from the test data showing an efficiency of 85.31 per cent. Line designations are the same as in Table SIb of the A.S.M.E. Power Test Code

		B.t.u. per lb. of fuel as fired	Per Cent
1105.	Heating value of fuel	9447.5	
1107.	Heat absorbed by water and steam in boiler	7100.50	75.16
1108.	Heat absorbed by steam in superheater	959.19	10.15
1109a.	Heat absorbed by steam generating unit	8059.69	85.13
1110.	Heat loss due to moisture in coal	185.30	1.96
1111.	Heat loss due to water from combustion of hydrogen	376.00	3.98
1112.	Heat loss due to moisture in air	15.40	0.16
1113.	Heat loss due to dry chimney gases	572.60	6.06
1115.	Heat loss due to unconsumed combustible in refuse	132.18	1.40
1116.	Heat loss due to unconsumed hydrogen and hydrocarbons, radiation, slagging, and unaccounted for	106.33	1.13

Table II. Pressures, temperatures and other significant data taken from the test form

GENERAL DATA	
Boiler heating surface, sq. ft.	9,480
Water wall surface, sq. ft.	3,052
Superheater surface, sq. ft.	2,867
Total steam generating unit surface, sq. ft.	12,532
Air heater surface, sq. ft.	17,920
Volume of comb. space, cu. ft.	9,296
Furnace volume per sq. ft. boiler and w. wall heat. surf., cu. ft.	0.742
GAS DATA ON AN AS FIRED BASIS	
Dry gas per lb. fuel, boiler outlet, lb.	9.674
Dry gas per lb. fuel, air heater outlet, lb.	9.738
Dry gas per lb. fuel, theoretical, lb.	7.497
Air supplied per lb. fuel, lb.	9.355
PRESSURES AND DRAFTS	
Steam pressure by gage, superheater outlet, lb./sq. in.	402
Draft at forced draft fan outlet, in. w.g.	+7.11
Draft in burner boxes, in. w.g.	+2.06
Draft in furnace, in. w.g.	—0.15
Draft at boiler outlet, in. w.g.	—1.21
Draft, air heater outlet, in., w.g.	—5.4
TEMPERATURES	
Steam temperature at superheater outlet, deg. F.	680.7
Superheat, deg. F.	231.7
Temperature of air entering air heater, deg. F.	110
Temperature of air leaving air heater, deg. F.	516
Temperature of air to air heater, deg. F.	110
Temperature of gases leaving boiler, deg. F.	598
Temperature of gases leaving air heater, deg. F.	355
Temperature of feedwater entering boiler, deg. F.	150.3
Temperature of fuel, deg. F.	72
Duration of test, hr.	7.0
Fuel per hour (as fired), lb.	14,571.7
Fuel per hour (dry), lb.	12,283.9
Combustion space per lb. of coal per hr. (as fired), cu. ft.	0.638
Actual water per hour, lb.	95,237.1
UNIT QUANTITIES	
Heat absorbed by water and steam in boiler, B.t.u./hr.	1086.41
Heat absorbed by steam in superheater, B.t.u./lb.	146.76
Rate of heat absorption in boiler, KB/hr.	103,466
Rate of heat absorption in superheater, KB/hr.	13.977
Refuse, % of fuel (as fired), %	17.75
Combustible in fly ash, %	8.55
Carbon burned per lb. fuel, lb.	0.5059

How To Conserve In

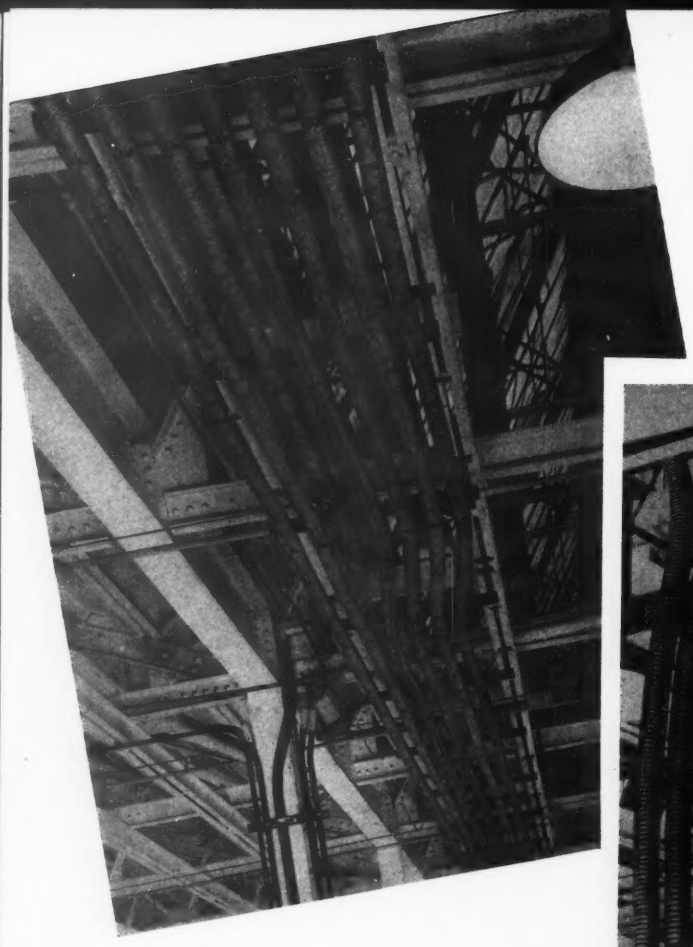


Fig. 1. A horizontal run of interlocked armor cable in one large defense plant

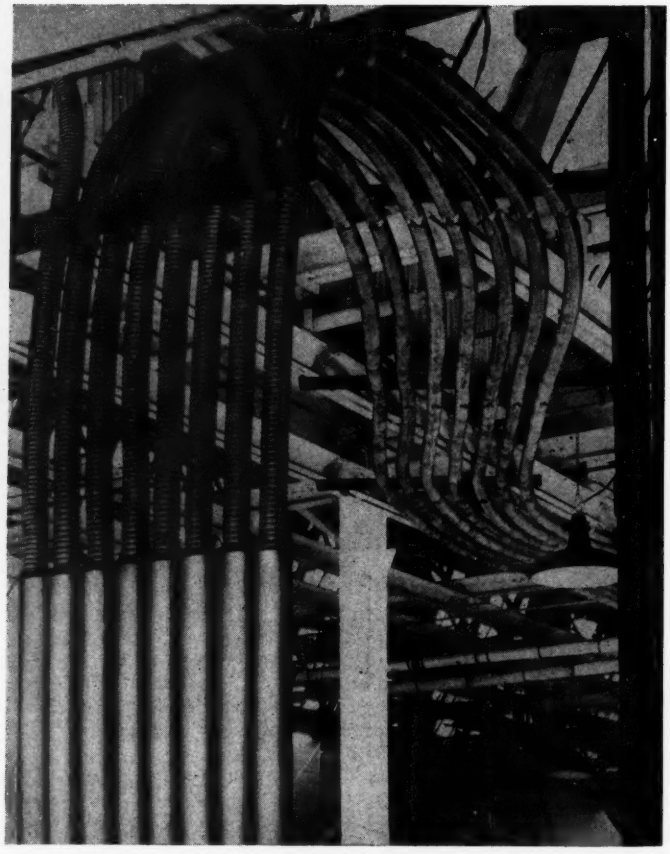


Fig. 2. Showing the method of bringing interlocked cable up through risers for additional protection from trucks, etc.

WITH the new restrictions on the use of rubber, and the increasing demands on our supplies of copper and steel, the problem of supplying insulated cable for the constantly increasing industrial power loads becomes a difficult one. It is possible, however, with the correct application of existing materials, not only to supply these demands for cable, but to save a large amount of vital material at the same time.

One method of conserving tremendous amounts of these vital materials is to use three-conductor, varnished-cambric, interlocked armor cable in place of the conventional conduit and rubber-insulated, single-conductor, cables. This method practically eliminates the use of rubber, and reduces the amount of steel and copper required for the feeder circuits of any distribution system, but is limited, of course, to reasonably dry locations such as are found inside a majority of industrial plants.

Varnished-cambric, interlocked armor cable is not an untried development, but has been giving satisfactory service at voltages ranging from 600 v. to 13.2 kv. in large industrial plants for over 10 yr. In almost all of these previous installations, interlocked armor cable was chosen rather than cable in conduit because it saved weight and space, and gave better voltage regulation, or cost less. Now that all of our resources are needed for maximum production, the saving of vital materials and time, and the better operation of electrical equipment are of the utmost importance. The use of V-C interlocked armor cable permits these savings to be made in industrial power circuits.

Saves Material

To illustrate the amount of material which can be saved, we have assumed that a new factory building 400 ft. by 750 ft. with a load of 3000 kv-a. is to be wired. For comparison we will distribute the power, first with a conventional radial system as shown in Fig. 3, and second with a load-center system[1] as shown in Fig. 4. For each system we will assume that the wiring is done, first with 3 single-conductor, rubber-insulated (30 per cent, 60 deg. C. compound) cables in steel conduit, and second with three-conductor, varnished-cambric insulated interlocked ar-

[1] For a detailed description of the load center system of distribution see pages 72 to 75, POWER PLANT ENGINEERING, March, 1942.

Vital Materials Industrial Distribution Systems

BY R. B. McKINLEY AND L. D. MADSEN
Wire and Cable Division, General Electric Co., Schenectady, N. Y.

mor cable as illustrated in Fig. 5.

For the radial system it has been determined that 5700 circuit ft. of 600-v. cable of a size to carry 240 amp. will be required. If 3 single-conductor, rubber-insulated cables in steel conduit are used, 350,000 circular mil cables will be required; if three-conductor varnished-cambric interlocked armor cables are used, 250,000 circular mil cables can be used.

For a load center system to distribute the same load to the same distribution centers, 1000 ft. of three-conductor, No. 6, 15 kv. cable will be needed to supply the load center units, and 1330 circuit feet of 600-v. cable will be required to supply the various distribution centers. The sizes of 600-v. cable required would be the same as for the radial system. With these quantities of cable, the weights of material required are as shown in Fig. 7.

From Fig. 7 it is apparent that tremendous savings in vital materials can be effected by using interlocked armor cables in either the load-center system or in the conventional radial system; over 250 per cent as much material being required for the wire and conduit construction. In addition to saving large amounts of copper and steel, V-C interlocked uses rubber only for the rubber-filled tape, as shown in Fig. 5, thus saving almost 100 per cent of the rubber required for the rubber-covered wire and conduit type of installation.

While this specific case was chosen for comparison purposes, the use of V-C interlocked armor cable will result in comparable savings in material for almost any new wiring installation or plant expansion.

Saves Time

Savings in time are often more important than lower cost in these days of rapid industrial expansion. Because of its flexibility, interlocked armor cable reduces to a minimum the time required for making layouts of electrical circuits. This permits orders for cable to be placed earlier, insuring that shipment can be made in plenty of time to meet installation schedules.

The time required for installation of power distribution circuits can be cut in half by using V-C interlocked armor cable instead of the conventional rubber-covered wire in steel conduit. This saving in installation time is due to the ease of making bends in interlocked armor cable, the possibility of making long runs without the necessity of making up numerous lengths of conduit and installing pull boxes.

The production time lost due to a cable failure will in most cases be much less with V-C interlocked cable than with a wire and conduit system. In the first place, a fault can usually be more easily located in the case of the interlocked armor cable. When the fault has been located it is usually possible to strip the armor for a short distance, spread the conductors apart and repair the fault, thus restoring service in a very short time. Although this type of repair is only temporary it will permit service to be restored until the permanent repair can be made without interrupting production. Repairing a fault in a wire and conduit system requires pulling the wires out of the conduit, locating the fault, repairing or replacing the damaged cable, and pulling the cables back into the conduit. This is obviously a longer job.

Saves Money

In addition to saving time and material the use of interlocked

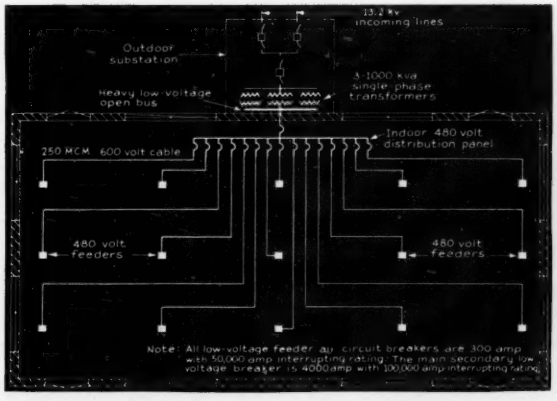

13.2 kv incoming lines
Outdoor substation
Heavy low-voltage open bus
3-1000 kva single-phase transformers
Indoor 480 volt distribution panel
250 MCM 600 volt cable
480 volt feeders
480 volt feeders
Note: All low-voltage feeder air circuit breakers are 300 amp with 50,000 amp interrupting rating. The main secondary low-voltage breaker is 4000 amp with 100,000 amp interrupting rating.

Fig. 3. A conventional radial system of distribution

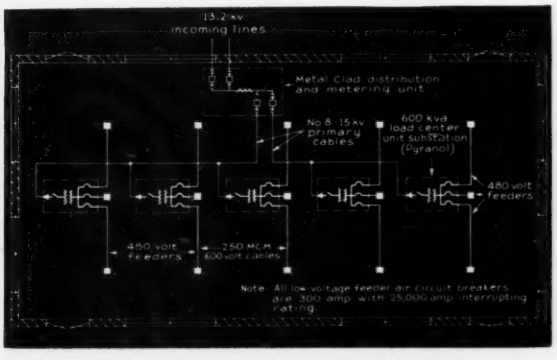

13.2 kv incoming lines
Metal Clad distribution and metering unit
No 8-15 kv primary cables
600 kva load center unit substation (Pyranol)
480 volt feeders
480 volt feeders
250 MCM 600 volt cables
Note: All low-voltage feeder air circuit breakers are 300 amp with 25,000 amp interrupting rating

Fig. 4. A load center system of distribution

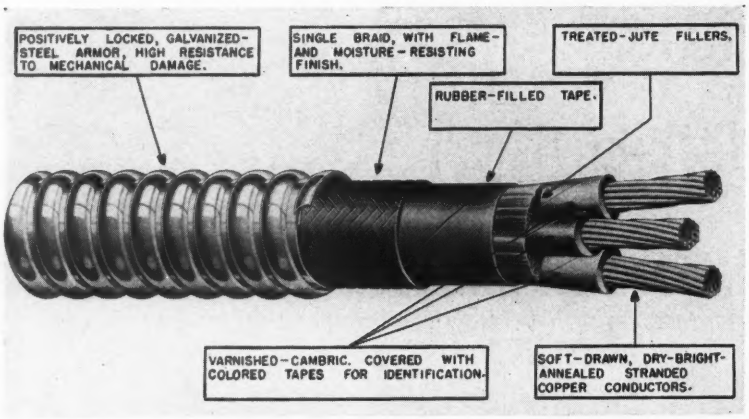

POSITIVELY LOCKED, GALVANIZED-STEEL ARMOR, HIGH RESISTANCE TO MECHANICAL DAMAGE.
SINGLE BRAID, WITH FLAME- AND MOISTURE-RESISTING FINISH.
TREATED-JUTE FILLERS.
RUBBER-FILLED TAPE.
VARNISHED-CAMBRIC, COVERED WITH COLORED TAPES FOR IDENTIFICATION.
SOFT-DRAWN, DRY-BRIGHT-ANNEALED STRANDED COPPER CONDUCTORS.

Fig. 5. G. E. 3-conductor varnished-cambric-insulated cable with interlocked spiral steel armor

armor cable permits a definite saving in initial cost. Comparative material costs of wire and conduit and interlocked armor cable systems are given in the following table.

	Total
CONVENTIONAL RADIAL	
Rubber in conduit	$10,510
V-C Interlocked	7,440
SAVINGS	3,070
LOAD-CENTER SYSTEM	
Rubber and V-C Lead in conduit	$ 3,644
V-C Interlocked	2,759
SAVINGS	885

In preparing these costs, the same power distribution system was assumed as in preparing Fig. 7. As in Fig. 7, no allowances were made for fittings since they will be approximately the same for both the conduit and interlocked armor systems. Neither has any allowance been made for the waste which should be greater for the conduit system than for the interlocked armor system.

Installation

In general the same junction boxes and clamps can be used for both the conduit and interlocked armor systems. The interlocked armor system requires the addition of connectors at the junction boxes, but this is offset by the elimination of pull-boxes which are necessary in the wire and conduit system. Connectors for the interlocked armor cable are available in the various sizes and their use eliminates the thread cutting necessary with conduit installation.

In many instances the interlocked armor cable can be laid in the trough formed by an I-beam or other parts of the building structure, thus eliminating the need for clamps and hiding all wiring from

Fig. 6. An entrance to a junction box, showing the ease of making this connection between the structural members

view. Interlocked armor cable can also be supported along the walls, along roof beams, or any other convenient structural members. A horizontal run in one large defense plant is shown in Fig. 1. These are three-conductor, 500,000 circular mil cables for 600-v. service. Note the neat appearance of the run and the simplicity of taking one cable out at right angles about the middle of the picture.

An excellent method of bringing the interlocked cable up through risers for additional protection from trucks, etc., is illustrated in Fig. 2. In this same illustration, note how easily the cables could be trained into place for the start of the long run shown in Fig. 1. Fig. 8 shows the simplicity of by-passing a large structural beam. Fig. 6 illustrates an entrance to a junction box, showing the ease of making this connection between the structural members.

Cable Construction

Varnished-cambric, interlocked armor cable is available in all sizes up through 750,000 circular mils and in the voltage ranges of 600 v., 5000 v., 7500 v., and 15 kv. As indicated in Fig. 5, the construction consists of 3 single-stranded conductors, each insulated with varnished cambric and cabled together with jute fillers. A layer of rubber-filled tape is then applied, followed by a flame and moisture-resisting braid. Over this is applied the strips of galvanized steel in the form of a positively interlocked armor. In order to

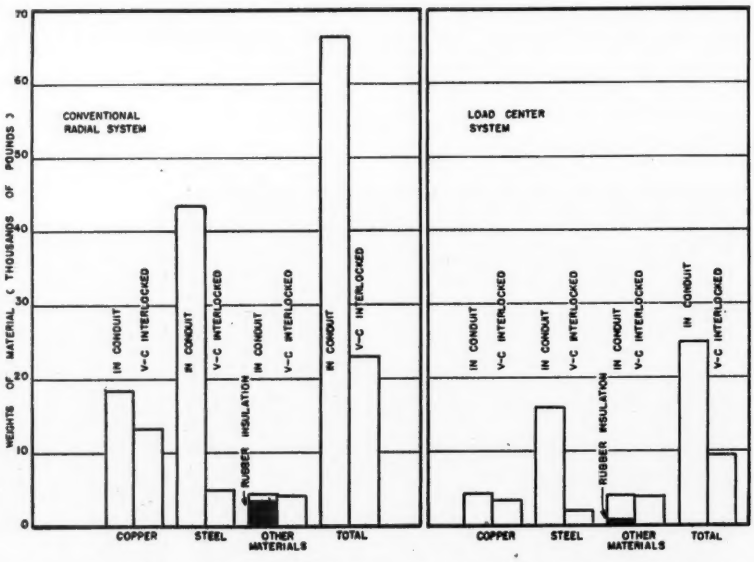


Fig. 7. Materials used for interlocked armor cable and wire and conduit in load center and radial distribution systems

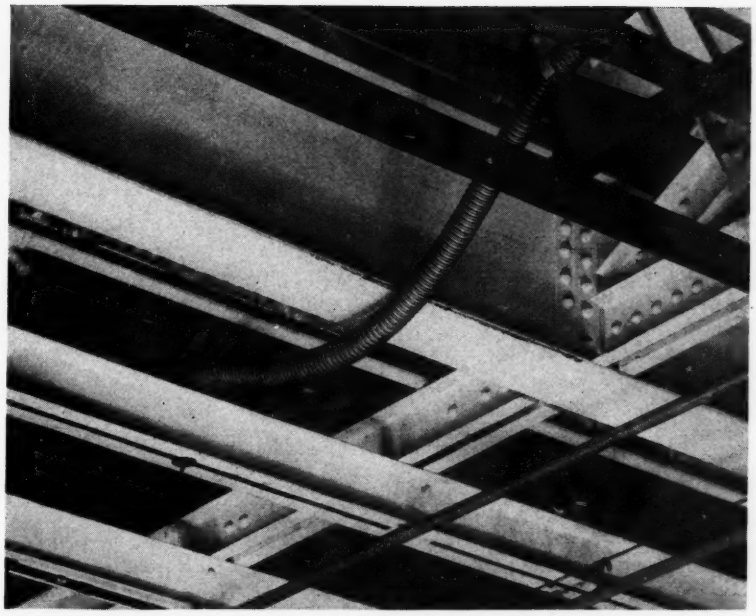


Fig. 8. A view showing the simplicity of by-passing a large structural beam

give greater protection, the 15 kv. cable is of the shielded type and has a lead sheath substituted for the tape and braid.

Interlocked armor, varnished-cambric insulated cable has been approved by National Electrical Code and listed by Underwriter's for use between 601 and 5000 v. It has been submitted for approval for use between 0 and 600 v.

Summary of Advantages

In recapitulating the advantages of interlocked armor cable over the conventional wire and conduit, the interlocked armor cable offers:

1. Savings in Vital Materials. More steel is "saved" in conduit alone by using the interlocked armor cable in the radial system than is used in the entire installation including transformers and switchgear for a load center system using interlocked armor cable.

2. Quicker Installation. About half as much time is required to install an interlocked armor cable as would be required to install a like amount of wire and conduit under similar conditions.

3. Shorter Layout Time. The time required to layout the circuits can be reduced to a minimum when interlocked armor cable is used because of the ease with which this type of cable can be bent around obstructions.

4. Lower Initial Cost. The cost of cable for a particular installation can be reduced approximately 25 per cent by using interlocked armor cable rather than wire and conduit.

5. Higher Salvage Value. Interlocked armor cable can be removed from one location and transferred to another as load conditions require. This cannot be done so easily in the case of wire and conduit since the conduit must be bent to fit.

6. Improved Voltage Regulation. Due to the closer spacing of the conductors in a three-conductor cable, better voltage regulation is obtained with the interlocked armor cable, resulting in better performance of electrical equipment and better products in larger quantities.

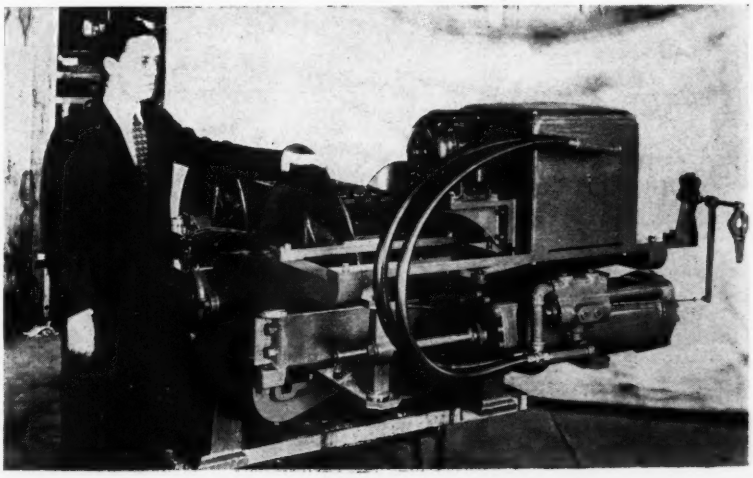
With these strong points in its favor, the use of varnished-cambric, interlocked armor cable should be considered for every industrial wiring and rewiring installation. The saving in time and material alone—two very important items in our War Production Program—should warrant its widespread acceptance and usage.

Hydraulic Control On Variable Speed Transmission

THE LARGEST variable speed transmission to be equipped with hydraulic automatic control was recently built by Reeves Pulley Co., Columbus, Ind., for use on a rotary veneer lathe in a S. C. plant.

This transmission, weighing 4300 lb. uncrated, is nearly 9 ft. long, 5 ft. wide and stands almost 4 ft. high, overall. It transmits 26 hp. at maximum speed and provides infinitely variable speeds over a speed ratio of 3:1.

The hydraulic control provides completely automatic speed variation on the transmission. The purpose, in this particular installation, is to maintain uniformly high peripheral cutting speed on the log from full original diameter down to the smallest diameter at end of the cut. Without this control, speed of rotation of the log would decrease as its diameter decreased, so that much less veneer would be cut toward the end of the run than at the start. However, with hydraulic control, peripheral speed is automatically increased as diameter is reduced, thus maintaining constant high cutting speed and production rate.



Combustion Safeguards For Boiler Furnaces

Furnace explosions occur as the result of bringing a mixture of combustible gas or vapor and air up to the ignition temperature. The author describes the most common conditions under which these explosions occur, how furnaces can be operated to prevent hazards, and the principles of safety devices that prevent explosive conditions

BY THEODORE A. COHEN
Chief Engineer
Wheelco Instruments Co.

RECENT trend in boiler design toward increased capacity of individual burners, with resulting reduction in number of burners, has increased the importance of proper safeguards to eliminate combustion hazards.

Accidental loss of ignition in boiler furnaces has always presented a hazard, and that hazard is even greater with forced draft burners that may fail during periods of low output. A hazard equally severe is presented when drying out or starting boilers.

Advances in boiler design that brought higher operating pressures and greater efficiency did not come without similar advancements in instruments and other devices to make such operation possible with safety. And one of the most important aids to safe operation is the modern combustion safeguard which gives complete protection over a long period without attention from the engineer.

Today, even the largest boiler may be adequately safeguarded against explosion hazard by judicious selection of draft switches, time delay units to insure purging, flame failure safety apparatus to insure instantaneous stoppage of fuel to burners in case of flame failure, and careful selection of apparatus to insure proper lighting procedure. Modern combustion safety devices have proved far more trustworthy than is the human operator when required to act with sufficient speed to prevent an explosion in case of unexpected circumstances.

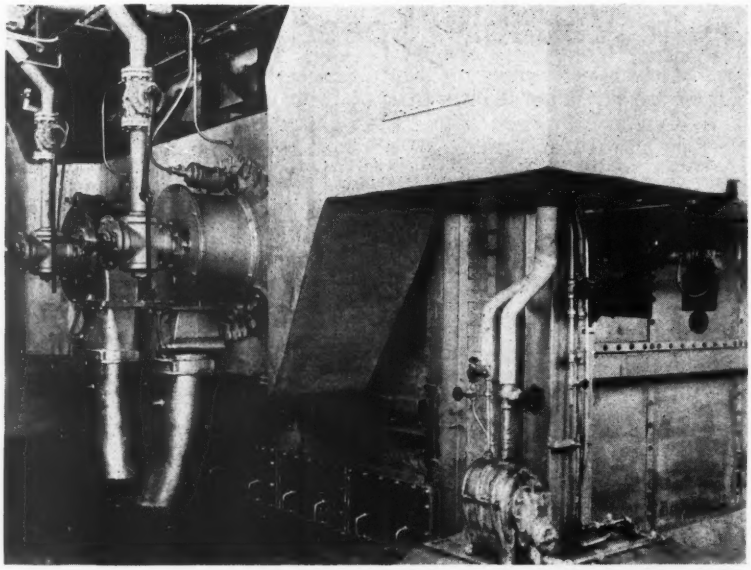


Fig. 1. Burner details of power boiler fired by gas, oil and pulverized coal fuels, used singly or in combination. Electrodes responding to gas flames, above burners at the left, electrode for oil or pulverized coal flames at extreme right

Explosions in furnaces occur most frequently during starting, particularly in gas and pulverized coal units. Fuel may leak past valves in the burner lines, to accumulate in the combustion chamber where an explosion may result on insertion of the lighting torch. Likewise, unburned fuel, in the case of oil and pulverized coal, may accumulate in the combustion chamber, and the gas distilled from it, upon mixing with air, may produce an explosive mixture that can be ignited during the lighting procedure.

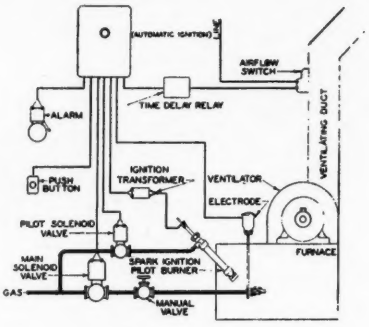


Fig. 2. Hook-up for gas fuel with provision made for controlled purging of the combustion chamber

No ignition attempts are made until the air flow switch and the time delay relay indicate the combustion chamber has been purged of all combustible vapors. When purging is completed, the instrument opens the solenoid pilot valve and turns on the ignition spark. The gas from the pilot burner is ignited by the spark, and the circuit is completed when the pilot flame comes in contact with the electrode. The main solenoid valve is then opened, allowing fuel flow through the manual control valve to the main burner, where the gas is ignited by the pilot flame. After a fixed time cycle, the spark ignition and the pilot burner are shut off. If, for any reason, the pilot burner does not light, or if the main burner fails to ignite from the pilot, the instrument immediately shuts off pilot and main fuel valves and sounds the alarm. A flame failure during operation also shuts down the burners instantly, and, after a purging period, determined by the instrument and set in accordance with the need of the equipment protected, causes a relight cycle

A second explosion hazard is presented when ignition is accidentally lost with decrease in fuel feed, or lost with stoppage of fuel, and then fuel feed resumed without repeating the proper lighting cycle. A part of the furnace may maintain sufficient heat for a short time to ignite the re-established fuel supply and provide means for an explosion.

A third explosion hazard is provided with a decrease in air supply to a point where unburned fuel may accumulate in the furnace or

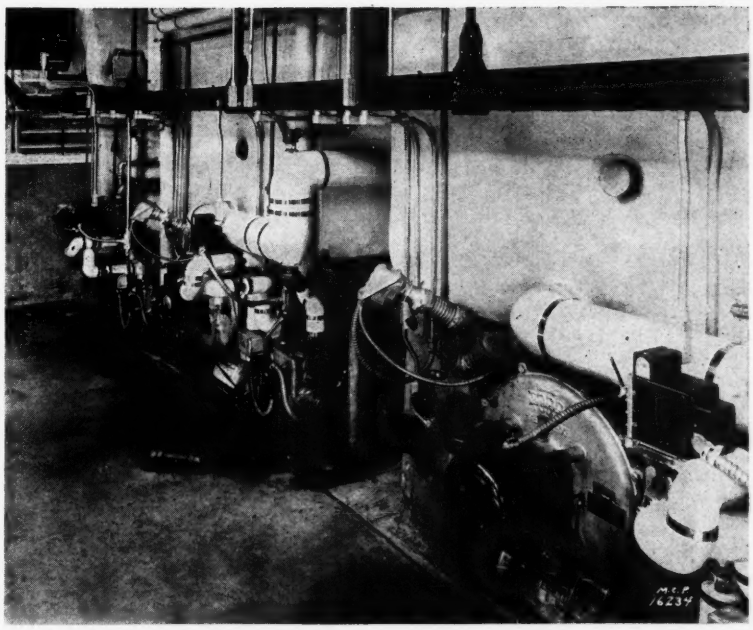


Fig. 3. These boilers, delivering heat and process steam and burning oil, are equipped with modern combustion safeguards. Photo-electric cells that hold fuel valves open during proper combustion are shown entering the combustion chambers at an angle from the left of the burner door. Electrodes, which respond to gas burning pilot lights to open fuel lines, enter the chambers just below the photo-electric cells

flues and ignite when proper fuel-air ratio is restored, or when the unburned fuel condition is changed to a condition of slightly abnormal excess air. This occurs more readily with oil or pulverized coal than with gas, and explosions from this cause have taken place in hand- and stoker-fired coal furnaces. Raw fuel entering the combustion chamber may not be completely consumed, due to insufficient oxygen brought about by air supply fan failure or some other cause. The fuel accumulates in some portion of the combustion chamber, and when the air supply is re-established, the gas in the pocket is diluted to present an explosive condition.

Explosion Prevention

It is apparent on analysis of the above explosion hazards that explosions cannot occur if:

1. The furnace has been purged of all fuel or hazardous vapors;

2. If, after purging, an ample igniting flame from torch or some other source is properly applied to each burner before fuel is turned on;

3. If air velocity at each burner is kept sufficiently low to prevent loss of ignition in starting;

4. If fuel is sufficiently rich to insure immediate ignition from torch, and

5. If, after ignition is established, proper mixture of fuel and air is maintained throughout the entire furnace operation, and stable ignition is maintained at all operation rates.

Similarly, after starting, explosions cannot occur:

1. If stable ignition has been attained;

2. If a flame failure at burner causes an instantaneous shutdown in fuel supply;

3. If a power failure to burner equipment causes an immediate shutdown in fuel supply, and

4. If a reduction or failure in air or fuel supply causes an immediate shutdown of fuel supply control means.

The necessity of thorough purging of the combustion chamber before lighting, and the importance of adequate flame failure safety protection equipment are clearly indicated when proper consideration is given all factors contributing to combustion explosions.

Purging, particularly required where gas is used, is also a necessity with oil and pulverized coal burning equipment. Pulverized coal or oil entering a furnace that is hot, but below the ignition temperature, may introduce a hazard by distilling gas, which, upon mixing with air, may ignite from hot brick work. There is a wider range of explosive limits where a hot furnace is slightly below the ignition temperature of the fuel, and if the fuel reaches a hot spot, a major explosion may occur with either a leaner or a richer mixture than would explode in a cold furnace when first lighting off.

Purging of small furnaces is often accomplished by natural draft, but in large units it is usually accomplished by an air flow switch in combination with a time delay relay that together supervise operation of a ventilating fan. The fan may be an exhaust type, pulling the gas from the furnace for replacement with fresh air, or may blow in fresh air to dilute and eventually force out all gases that

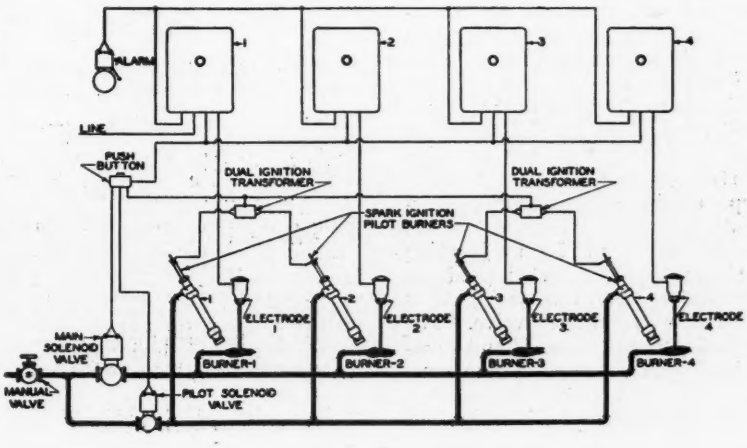


Fig. 4. Diagram showing a multiple-burner gas boiler equipped with combustion safeguards

It is unsafe to ignite one burner from the burner adjacent, especially with large capacity burners. This makes advisable use of safety equipment for guarding individual burners against flame failure. Depression of the push button shown in the diagram opens the pilot valve and energizes all spark ignition pilot burners through ignition transformers. When the pilot flames touch the flame electrodes, the instruments open the main solenoid valve and the main burners are ignited by the pilot burners. Upon flame failure at any of the burners, the main valve and pilot valve both close and the alarm bell rings

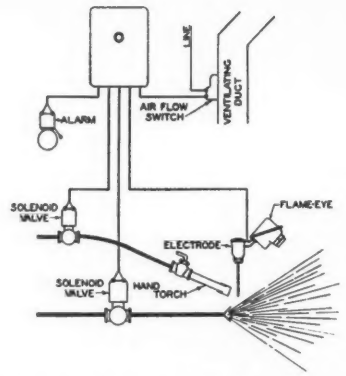


Fig. 5. Combustion safeguard for a system burning oil or pulverized coal

The instrument provides a purging period, during which the hand torch cannot be ignited. After the purging period, the hand torch solenoid valve is automatically opened. The manual valve on the torch may then be opened and the torch ignited. When the torch is inserted through the lighting port so that the flame touches the electrode, the instrument opens the main fuel valve. No oil or pulverized coal can reach the burner until a flame is present to light it, and no flame can be introduced into the combustion chamber until the chamber has been purged of all accumulated combustible vapors. The hand torch is withdrawn from the chamber after lighting, and its manual valve closed. If the fuel has been successfully ignited, the photo-electric cell will react to cause the instrument to keep the fuel valve open. If ignition is unsuccessful, the valve will be shut down and the alarm bell will ring. A flame failure during the operating period causes an instant shut-off, sounding the alarm bell

might have accumulated in the chamber.

A flame-failure safety device must cut off the fuel supply to a burner in case of flame failure or loss of ignition, and must provide the cutoff quickly to prevent raw fuel from entering the combustion chamber after the flame failure has occurred.

Early flame-failure devices fall into two general classes, both making use of heat from the flame. One type employs a heat sensitive member, such as a thermostatic strip or a thermometric bulb with an expansible liquid. This member, on being exposed to the source of heat, operates an electric contact to energize the fuel supply valve, or it might act directly upon such a valve to maintain the fuel flow to the burner as long as heat is radiated from the flame to the thermally sensitive portion of the apparatus. Another type employs a thermocouple, essentially two dissimilar metals welded together to form a junction which, upon being heated, produces an electric current flow in a low resistance magnetic valve. The valve is manually opened and maintained open while the thermo junction is heated by the burner.

In these classes of equipment, flame failure must allow the thermally sensitive members to cool if the fuel control valves are to be closed and the fuel supply to the burner cut off. In actual operation, however, sources of heat other than the flame may impinge upon the thermally sensitive members and maintain the fuel supply valves open for a considerable length of time after flame failure. Such extraneous heat might come from radiant insulation in the combustion chamber, burning fuel that may have dripped upon the surface of the burner mounting wall, or hot ceramic tips of the burners.

To overcome these objections, the lesser known ability of a flame to conduct an electric current was employed in a combustion safeguard instrument. An electrode is introduced into the flame and connected to the instrument. As a conductor of electricity, the flame has a definite range of resistance, readily distinguished from that of any other medium. The instrument reacts in accordance with the amount of resistance in its electrical circuit, of which the flame is a part. The resistance of the circuit remains within certain constant limits as long as a flame is in contact with the electrode, and the instrument holds open fuel valves in the burner fuel line and maintains combustion. Flame failure, however, increases the resistance in the circuit, and the instrument instantly closes the fuel valves to prevent flow of fuel to an unignited burner. When a burner is being ignited, a pilot light, also in the circuit and in contact with the electrode, provides the necessary resistance in the circuit to enable the instrument to open fuel lines to the burner.

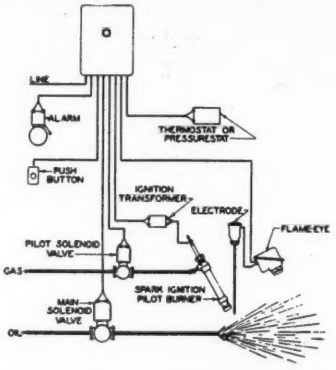


Fig. 6. Combustion safeguard incorporating a controller, which may be either a pressurestat or thermostat

A demand for heat by the controller is transmitted to the instrument, which turns on the spark ignition and pilot burner. When the pilot light strikes the electrode, completing the circuit, the main fuel valve is opened and oil or pulverized coal admitted to the combustion chamber where it is ignited by the pilot flame. After a fixed time period, the pilot and ignition are shut off. If the ignition cycle has been satisfactorily completed and the main fuel flame established, the fuel safety valve stays open, held in that position by the photo-electric cell, and the instrument ignition control assembly re-sets itself, automatically, for a new lighting cycle when required. In the case of flame failure after the ignition period, the oil valve is instantly shut off, and a new lighting cycle takes place

For use with fuels other than gas that burn with luminous flames, a device incorporating a photo-electric cell is employed in place of the electrode.

Protection Extended to Instrument Failure

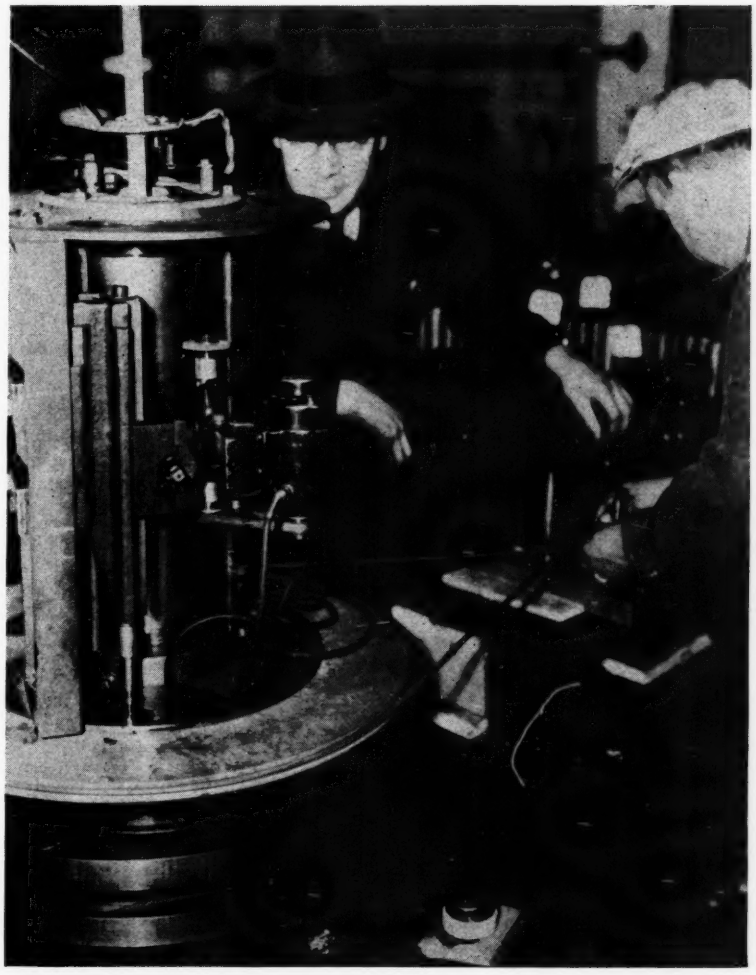
Modern combustion safeguard instruments, after shutting both main and pilot valves upon flame failure, provide a time delay for purging the chamber of combustible gases before lighting is permitted. They are designed for all applications where combustible gases might be present, and purging time is usually fixed at the factory to prevent tampering.

A guarantee against explosions resulting from failure of any part of a modern combustion safeguard instrument or a short in the circuit is provided, as the device then closes fuel valves as it does in case of flame failure. In this manner, the safeguard protects not only against human failure, but also against any deficiency that might develop in the instrument itself.

PETROLEUM INDUSTRY BUILDS NEW LINES

In 1941 America added more than 4500 mi. of petroleum pipe lines to its system, about half of it in strategic locations directly concerned with national defense. The remainder was built in the normal expansion of the petroleum industry. Three strategic pipe lines built in 1941 will have an immediate effect on national defense by leasing tank ships for other service. These are a 250-mi. line from Portland, Maine, to Montreal, Canada; the 450-mi. line from Port St. Joe, Florida, to Chattanooga, Tennessee; and a 1260-mi. line from Baton Rouge, Louisiana, to Greensboro, North Carolina.

Total pipe-line mileage in the United States at the end of 1941 is estimated at 131,000 mi. of which 11,500 are refined oil lines, and nearly 120,000 are crude oil trunk lines and gathering lines.



View showing the arrangement devised for truing the thrust block surface and the circular keyway on a vertical waterwheel generator. It shows the upper and lower guides which rode on the smooth portions of the shaft, separated by pieces of channel iron. The compound tool rest with its small motor driven grinder, as shown, was attached to one of these channels. The whole rig was rotated by the 20-in. wooden pulley at the bottom

Machining on Job Saves Time

A MACHINING JOB necessary on the rotor of an old waterwheel generator was done right at the station in 2 days' time recently under the supervision of R. J. Ruedy, of General Electric's Boston Office Engineering Department. Loss of proper alinement of parts on vertical shaft units of this type sometimes results in working of the thrust collar on the shaft. Flat spots on the shaft then usually develop from the movement between shaft and collar, requiring the shaft to be trued up. Ordinarily, this would be done by removing the shaft to a shop where it could be swung on a lathe. Besides truing up the shaft, the thrust-block would be bored out and bushed, and the block rebored to the new fit.

Because the rotor of this unit could not be removed without practically dismantling the station a rig was made up to grind the shaft fit by rotating the grinder around the vertical stationary shaft. It consisted of an upper and lower guide, each with three adjustable brass blocks for centering and maintaining close running clearance. These two guides were joined together rigidly by two pieces of stiff channel iron and so spaced that they rode on smooth portions of the shaft, which were true in accordance with the original machining. A compound tool rest was secured on one of the channels to support a small motor-driven grinder with a 2-in. wheel operating at about 13,000 r.p.m.

A 20-in. wooden pulley was secured to the lower guide and belted to a ⅓-hp., 148-r.p.m. gearmotor with a small pulley. This drove the rig and grinder around the shaft at approximately 14 r.p.m. The parallel feed of the tool rest was connected to a 6-spoke starwheel below the wooden pulley and a stationary pin was located to turn the feed screw one spoke for each revolutiton of the rig, thereby accomplishing automatic feed of the grinder up and down the shaft. A collector ring from an old single-phase motor was mounted on top of the assembly for power supply to the grinder. The entire arrangement is shown in the accompanying photograph.

Once the rig was set up and adjusted 2 days of grinding were necessary to true up the shaft fit satisfactorily by this method. A pin gage was made for the new diameter with allowance for the desired fit. The thrust block, with its bore built up by metal spraying, was ground out to this pin gage. The thrust block was warmed to about 75 deg. C., which allowed the block to slide in place easily on the shaft.

Correcting the thrust block fit by this method was accomplished in considerably less time than would have been needed to remove the rotor from the machine, and the final results were entirely satisfactory.

This is a good example of how a little ingenuity and resourcefulness properly applied can save an immense amount of time and effort. To dismantle this machine and to transport the pieces to a machine shop might have resulted in an outage of weeks instead of days.

Utility Operating Problems During Blackouts

There has been much discussion and not a little confusion in regard to procedure and the effect of emergency and test blackouts in this country since December 7. Electric Utilities are of course vitally concerned in what happens to the load just before, during, and immediately after the blackout and a number of reports have been issued showing the effect of blackouts on load. As a consequence of his many contacts with utility men throughout the country Mr. Starr of the General Electric Co. has accumulated considerable information on the problems involved in blackouts and in this article he discusses them briefly and concisely

By F. M. STARR
General Electric Company
Schenectady, N. Y.

AFTER PEARL HARBOR, the West Coast cities had nightly blackouts. These were discontinued after Dec. 15, but may be expected to recur at any time following an alert warning. Many other cities, particularly the coastal cities and the industrial cities, have had practice blackouts. It is to be expected that all cities of any military importance will have practice blackouts soon and many of them will have had actual precautionary blackouts.

What are the principal problems of the utility engineer in connection with blackouts and what are their solutions? The author has had occasion to discuss these problems with a number of utility engineers throughout the country during recent weeks and here are summarized the principal thoughts along these lines.

The principal problems are as follows:

1. Ways and means of getting street lights out.
2. The effect on the system of suddenly dropping a large amount of load.
3. The effect on the system of suddenly taking back a large block of load.

Dropping Large Increments of Load

Most engineers believe that nightly blackouts, such as they have in England, will be unnecessary in this country. Such blackouts as do occur will come only as a result of the alert alarm and will involve the element of surprise. Most practice blackouts, so far, have not involved the element of surprise since everyone has known within an hour or so when the blackout was to take place.

To this extent, therefore, practice blackouts must be considered only partially successful. It is further significant that practice blackouts have lasted 10 or 15 min. in most cases, as compared to the more likely 2 or 3 hr. of the actual precautionary blackout. Moreover, when practice blackouts have been tried, many people had failed to make the necessary preliminary preparations to permit normal living in a well lighted room. Many factories, largely due to lack of time, had also failed to make the necessary preparations to permit continuous operation during the blackout. The result has been that in both the factory and the home, normal activity ceased and all lights were turned out for the duration of the blackout.

For these reasons, therefore, much load data accumulated by the power companies during practice blackouts cannot be considered as entirely indicative of what may be expected under conditions of actual surprise blackouts and after all preparations for them are actually complete. The data is useful, however, if properly interpreted.

For example, Schenectady had a 10-min. blackout recently at about 9 p. m. However, the domestic and commercial load started dropping below normal shortly after 7 p. m. This load was 30 per cent below normal during the blackout, but the actual increment of change after the alarm was only about 10 per cent. When the alarm was over, the load never did get back to its normal value. It is expected that later, when preparations are more complete, this drop of 30 per cent will be much less. It is also expected that the change will always be sufficiently slow as to cause no trouble at all. The only single element of load which is likely to go off instantly is street lighting, and this is always less than 1 per cent of the total load.

Most utility engineers feel that, in the large industrial cities where the industrial load greatly exceeds all others, the maximum change in load following a blackout will not exceed 15 per cent. It is true that on the West Coast. loads dropped off from 30 to 40 per cent during the week of blackouts, but here again many people were unprepared and blacked out by simply turning off all lights.

Restoring Service Following Blackouts

It is further to be noted that most utility engineers are agreed that opening feeder switches is not a satisfactory method of effecting blackouts. This procedure would cut-off essential loads such as pump motors, oil-burners, radios, etc., and also would result in an unnecessary loss in revenue.[1]

In pondering the question as to how much load could be dropped over a period of a few

[1]In one case of a trial blackout where this method was used, the opening of a feeder switch cut off the source of supply to the air raid siren.—Ed.

"Oh— So you thought it would simplify matters to paint out the lights rather than those large windows, did you!!!?"

minutes without any trouble, most operating engineers feel that 40 to 50 per cent load could be dropped with no more ill effects than a momentary change in frequency and voltage, and the discharging of steam through relief valves.

Picking up load following a blackout is likely to be more of a problem than dropping it. Picking up too much too quickly might cause instability and also reduced voltage and frequency, and might introduce serious temperature stresses in turbines and boilers. However, most systems, especially those carrying heavy industrial loads are designed for sudden increases or shifts of sizable loads. Many systems have at least 10 per cent "spinning reserve" generating capacity available continuously.

An actual blackout is likely to last some time, perhaps several hours, which would provide time to prepare for any heavy load demands coming on at the end of a raid or an alert. However, all experience to date indicates that the increase in load at the end of a blackout will always be substantially less than that which was dropped at the start. Experience also indicates that this increase will be fairly gradual and not sudden. The consensus is that picking up the blackout load will not be a serious problem with most utilities.

Controlling Street Lighting

Some street-lighting systems have centralized control. Others do not. A common method of controlling street lights is the astronomical dial type of time switch which is, of course, decentralized automatic control. Types of control which are being proposed to facilitate blackouts are (1) manual, (2) pilot wire, and (3) carrier current.

Pilot wire control is expensive, and is not known to have been used to control street lights as a general solution. Carrier current control is a reliable method and has been used in a number of instances. Several West Coast cities are now seriously considering low-frequency carrier for street light control in blackouts.

Eventually this may prove to be the general solution. However, if very many cities are faced with periodic blackouts, in the near future, most of them will have to adopt some system of manually switching the street lights. This is because a large number of centralized control systems cannot be put into service in a short time. Manual control simply means assigning reliable persons such as air-raid wardens, employes, etc., to be responsible to specific switches which they can reach on short notice. Of course, certain pre-arrangements which can be made quickly will greatly facilitate this manual control. In many cases, the installation of a few control relays and control circuits will permit the operator to control a number of street lights with one switching operation.

To summarize, when blackouts become well-organized and all power customers follow intended procedures, the change in load—either before or after the blackout—will be sufficiently gradual and sufficiently small as to present no serious problem to most power companies. Getting street lights off and on may present something of a problem if they are not centrally controlled. Carrier current or pilot wire systems will solve this problem, but temporarily many companies must organize a system of localized manual control.

High Altitude Lightning

ANOTHER POPULAR belief about lighting has been shattered by research engineers. Contrary to general opinion, lightning strokes are more severe at low altitudes than in high mountainous regions, according to an A.I.E.E. report by L. M. Robertson of the Public Service Company of Colorado, W. W. Lewis of the General Electric Company's Central Station Engineering Department, and C. M. Foust of that company's General Engineering Laboratory. The report concludes a 5-yr. study of lightning and corona currents on the Colorado Public Service Company's Shoshone-Denver 100-kv. transmission line, which runs through the heart of the Rocky Mountains.

Constructed in 1908 and 1909 on steel towers, the line is not equipped with overhead ground wires, but rather a single continuous counterpoise wire which is buried in the ground at an approximate depth of one foot wherever possible. Over the high passes at Argentine (altitude 13,500 ft.) and Hagerman (altitude 12,000 ft.) a double counterpoise has been installed.

Based on some indications that currents in lightning strokes might be smaller and less destructive at high altitudes than at lower altitudes, measurements were started in 1937 by installing surge crest ammeter links on some of the towers. With the installation of brackets on certain towers where past experience indicated that most lightning activity had occurred, and on the counterpoise for most of its length, the general investigation was underway by 1938. Then in addition, in 1940, data on corona discharge levels and polarities over a wide range of elevations was obtained by the installation of corona and surge voltage recording units at three points.

As a result of this concentrated study, several new conceptions have been established. At 18,000 ft., the report shows, there may be an absence of lightning strokes altogether. The probable lightning stroke current decreases with the increase of altitude from sea level to 18,000 ft., at which point the current would reach zero. This is due in part to the fact that the breakdown strength of air decreases about 3 per cent per 1000 ft., so that at 6000 to 13,500 ft. its strength varies between 60 and 80 per cent of that at sea level. With less voltage available between cloud and earth, lightning current values are usually lower. Projection of mountains into the cloud regions limits the accumulation of charges by increasing cloud-to-ground leakage, at the same time precipitating discharges before a cloud charge can be built up to average low-altitude lightning proportions.

The investigation has further disclosed that the highest mean temperatures at 18,000 ft. do not exceed 32 deg. F. The mean temperature taken at an altitude of 13,500 ft. conforms very closely with temperatures at corresponding altitudes in free air as obtained by trial balloons. This coincides with the theory that freezing temperatures may limit the formation of lightning. Contour of the ground, say the authors, and its relation to the direction in which the storm is traveling appear to have more bearing on the location of lightning strokes than geological formations.

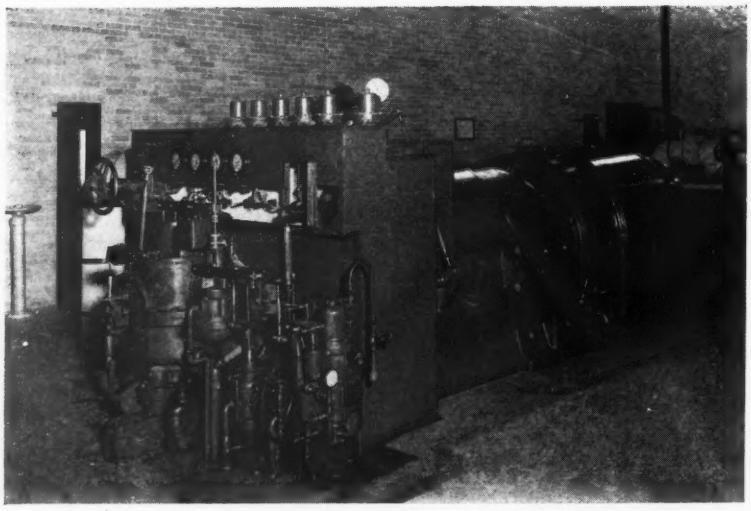


Fig. 1. One of the two turbine generating units in the new power plant of the Ottawa Silica Co.

POWER FOR MINING SILICA

Silica sand produced by reducing sand stone rock is mined and purified by the hydraulic process, power for which is supplied from a new plant just put into operation by the Ottawa Silica Co. at Ottawa, Ill.

ELECTRIC POWER, great quantities of water under pressure and heat for processing are the services demanded of the new power plant of the Ottawa Silica Co. at Ottawa, Ill. Several years ago it was realized by officials of the company that the facilities rendered by the old plant were being outgrown and studies were begun to determine how best to utilize modern power house equipment in the solution of the service problems encountered. The result of these studies is now in material form, the plant having been put into operation during the latter part of January. So rapidly has the demand grown for the company's products, however, that even at this early date in its history the plant is overloaded and further extension is in the immediate future.

Outline of Mining Process

Not far from the junction of the Fox and Illinois Rivers is a rock deposit known as St. Peter Sand which even in its deposited state is almost pure silica dioxide. It is covered with an overburden of earth only a few feet thick. When this is removed, which is done by excavators, the exposed surface of the rock is swept clean and the side of the cliff is blasted into the pit.

This blasting disintegrates the stone into small particles and from this point on the mining, as it is called, is done by the hydraulic process. Strong jets of water further reduce the size of the sand particles, give them their first washing process, and force the sand into a sump pit whence it is forced by steam and electric pumps to the main sump at the base of the mill. From here on the process consists in purifying the sand, principally by means of flotation, then drying and preparing it for shipment.

Power Requirements

This silica sand is recognized as the very highest quality for molding purposes, particularly in steel foundries because of its high fusion temperature, around 3200 deg. F. and this fact has been one of the reasons for its increase in demand during the national emergency. Other uses for this silica sand are for sand blasting, in building construction, for stone sawing, refractory brick, glass, abrasives, and numerous chemical applications.

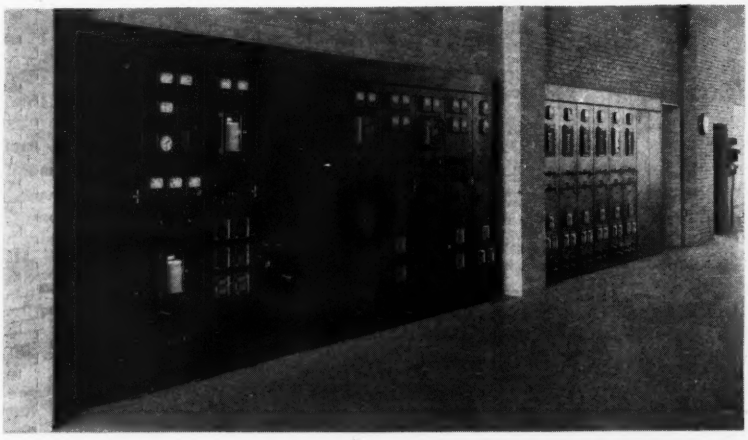


Fig. 2. Control and switchboards in turbine room

Thus it will be seen that the principal power load on the plant is for pumping water and for power and lighting about the mills. Heat in large quantities is required for drying purposes and in winter the water used for washing down the banks of sand and sluicing must be raised in temperature to prevent freezing.

With these problems facing the engineers a site was selected as near the working face of the cliff as was thought advisable, considering the shifting of workings during the probable life of the plant. Condensing water is taken from natural ponds adjacent to the plant. A railroad siding brings coal directly to the plant. Steam for drying is piped underground from the plant to the point of use as is the condenser circulating water in the winter time when used to temper the mining water. In summer, however, the pond is used for cooling purposes with provision for partial recirculation during freezing weather is found necessary.

The principal units in the power plant consist of two identical turbine-generating units of 1250 kw. capacity each, which are supplied with steam from three water tube boilers each of 455 hp. capacity. Coal used is 1¼-in. screenings either from Fulton County Zeigler mines, or from local strip mines. This is dumped into track hoppers at the plant and either delivered to the yard for storage or elevated, conveyed and distributed by means of Redler conveyors to the boiler bunkers which have a capacity sufficient to serve the plant for one day.

Steam Generation

The boilers, three in number with space provided for additional units, were furnished by the Wm. Bros Boiler & Mfg. Co. and are of the three-drum type designed as a unit with the furnace served by spreader type stokers. Combustion air is preheated and both forced and induced draft fans are operated under the control of Hays regulators. Steam is generated at 450 lb. pressure from feedwater at a temperature of 325 deg. F. to steam at 600 deg. F.

Coal is automatically weighed as it is delivered to the boiler by Richardson scales; make-up feedwater, which comes from a pond, is treated by a zeolite softening system, then, in combination with the condensate returns, is passed through a deaerating direct contact heater of 100,000 lb. per hr. capacity on its way to the boiler which it enters at a temperature of 325 deg. F., the amount having been recorded by flowmeters. The condition of the boiler water is maintained by a continuous blowdown system. Steam and air flow are recorded by Bailey boiler meters for the guidance of boiler operators, the instruments being mounted on operating panels.

Serving each boiler is a three-element spreader type stoker which employs a dump grate oper-

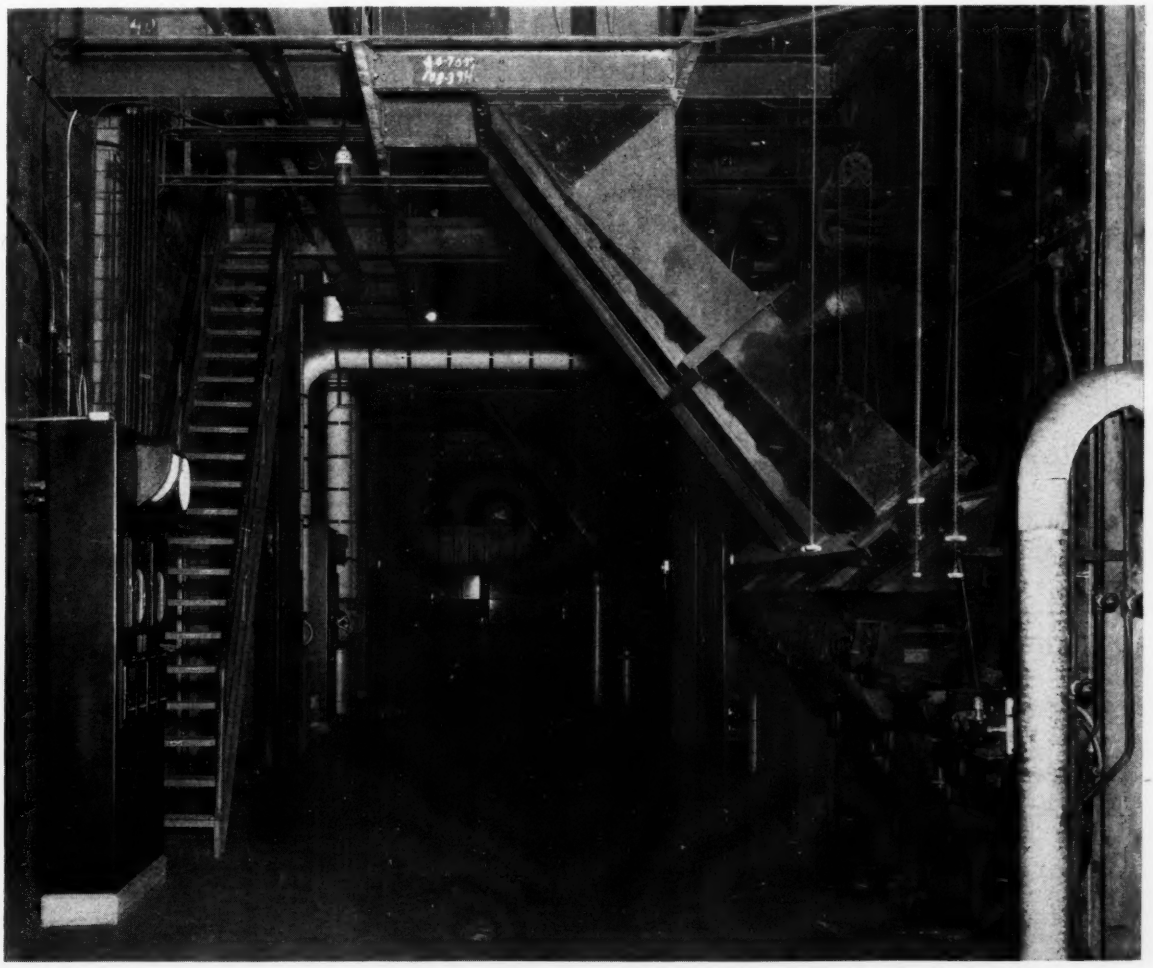


Fig. 3. Boilers are fired with spreader type stokers under automatic control

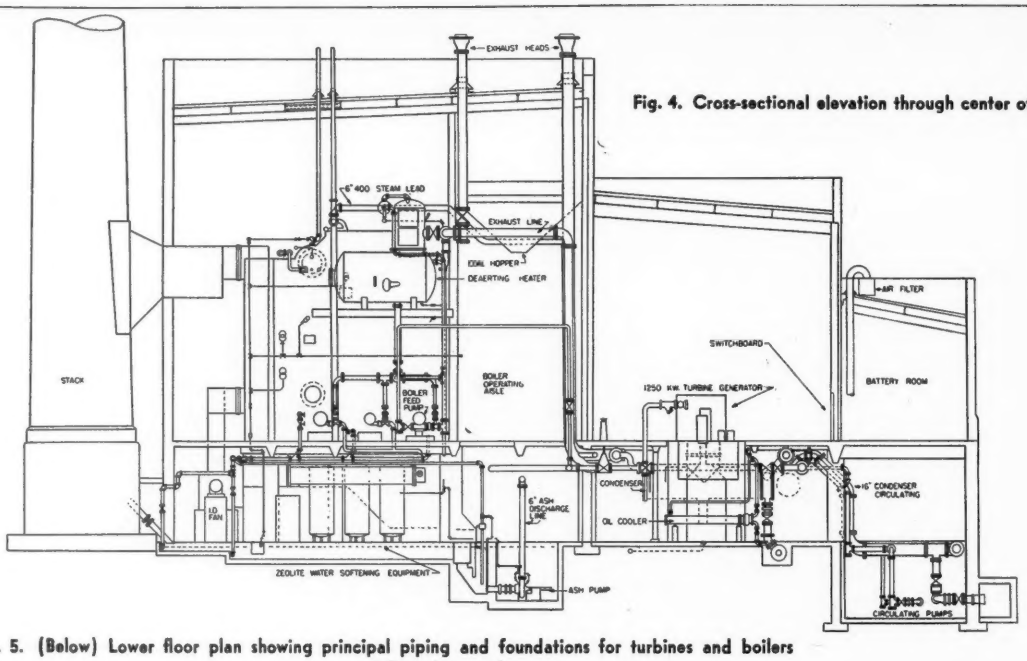
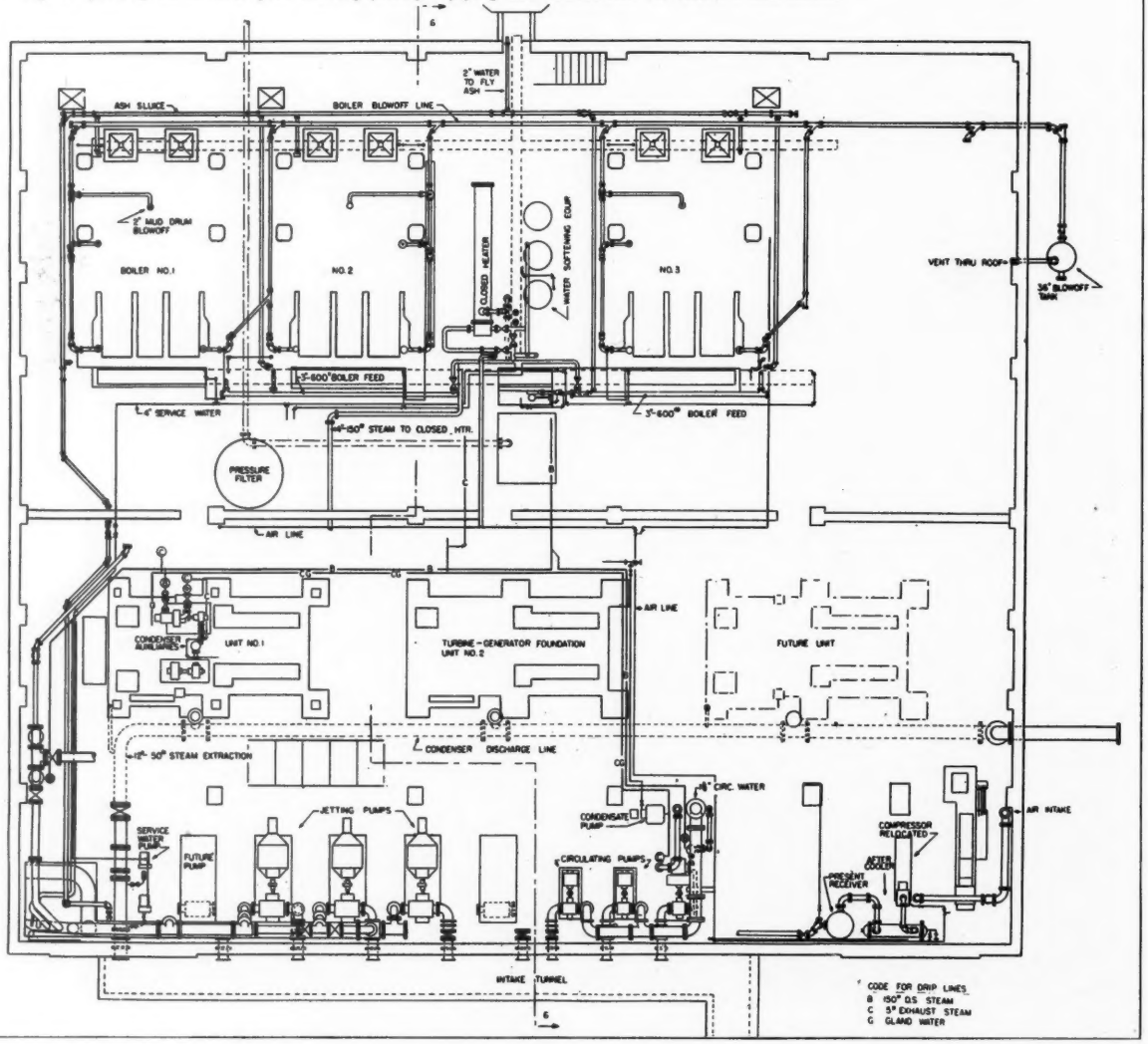


Fig. 4. Cross-sectional elevation through center of plant

Fig. 5. (Below) Lower floor plan showing principal piping and foundations for turbines and boilers



ated by a steam ram. Turbulence of the furnace gases is obtained by means of a steam jet. Ashes and clinker are hand drawn into an Allen-Sherman-Hoff sluicing system that discharges into the yard where the ash is used for fill.

Turbine Features

In the turbine room, two Allis-Chalmers units, with direct connected exciters and generator air cooling equipment, are installed, with space provided in the building for another of the same capacity, 1250 kw. at 70 per cent power factor. An auxiliary exciter consisting of a 15-kw. motor generator set is provided. These turbine units are of the condensing type with automatic extraction taking steam from the boilers at 450 psi. 600 deg. F. and delivering

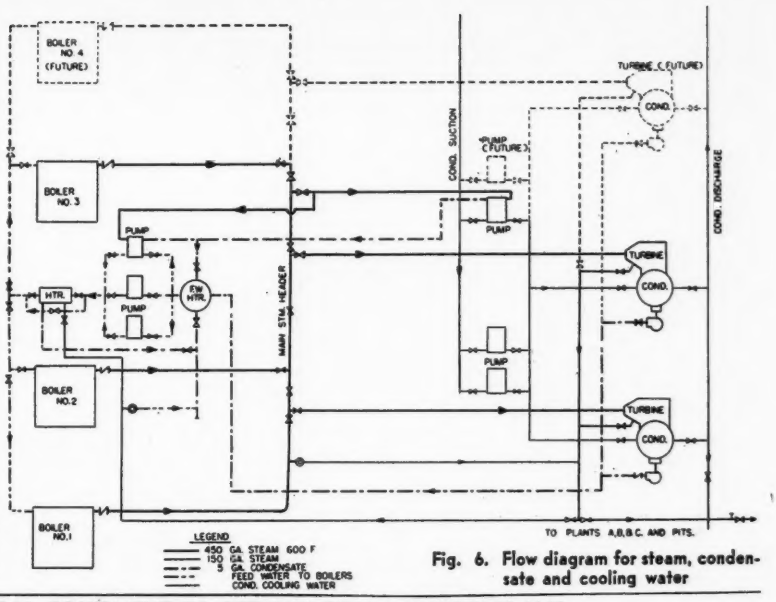


Fig. 6. Flow diagram for steam, condensate and cooling water

LIST OF PRINCIPAL EQUIPMENT IN OTTAWA SILICA POWER PLANT

Boilers—Wm. Bros Boiler & Mfg. Co., 3—35,000 lb. per hr., 455 hp., 450 psi. 325 deg. F. feedwater, 600 deg. F. steam. 3-drum water tube.

Stokers—Wm. Bros Boiler & Mfg. Co. 3 units per boiler, spreader type.

Grates—Hulson Grate Co. Hulson unit tuyere type 16-in. dumping.

Ash Handling—Allen - Sherman - Hoff Co. Hydraulic sluicing.

Steam Washers & Purifiers—Wm. Bros Boiler & Mfg. Co.

Soot Blowers—Bayer Co.

Boiler Safety Valves—Crosby Steam Gage & Valve Co.

Boiler Gauge Columns—Reliance Gauge Column Co.

Blowoff Valves—Okadee Co., 400 to 600 W.S.P.

Boiler Blowdown — Cochrane Corp. Continuous.

Draft Fans—Clarage Fan Co., 3 f.d. No. 2½, 15,000 c.f.m., 1200 r.p.m. motor driven, 3 i.d. No. 4R+, 52,500 lb. gas per hr., 450 deg. F. motor drive.

Chimney—Alphonse Custodis Chimney Construction Co. Brick 8 ft. dia., 125 ft. high.

Feedwater Heater—Swartwout Co. 1, deaerating, direct contact, 100,000 lb. per hr.

Water Softener—Cochrane Corp., Zeolite system, 35 g.p.m.

Coal Handling System—Stephens-Adamson Mfg. Co., Redler type. Capacity 50 t. per hr.

Coal Storage and Reclaiming—Sauerman Bros. Power drag scraper system.

Coal Scales—Richardson Scale Co. 3 totally enclosed, dustproof, all electric, automatic weighing hopper. 200 lb. capacity, 12 t. per hr. each.

Boiler Meters—Bailey Meter Co.

Feedwater Control—Bailey Meter Co.

Combustion Control—Hays Corp. Regulates forced and induced draft fans.

Flow Meters—Republic Flow Meters Co. 3 recording and integrating on steam distribution lines.

Pressure Gages — Consolidated Ashcroft-Hancock Co., Inc. Steam and water.

Boiler Feed Pumps — Allis-Chalmers Mfg. Co., 3, 4-stage, centrifugal. 2 motor driven, 100-hp. motors 440 v., 3-ph., 60 cyc. 3550 r.p.m. 1 turbine driven, 90-hp.

Circulating Pumps — Allis - Chalmers Mfg. Co. Condensing water, 2 motor driven, 1 turbine driven, 20-hp. each.

Pumps, Jetting and Mining, and Controls—Allis-Chalmers Mfg. Co. 5-centrifugal, 500-hp. synchronous motors.

Turbine Generating Units—Allis-Chalmers Mfg. Co. 2, 1250 kw., 70 per cent p.f. single cylinder, 450 psi. condensing, automatic extraction at 150 lb., direct connected exciter, 90 deg. F. generator air coolers and auxiliaries. 2300 v., 60 cyc., 3-ph., 3600 r.p.m.

Condensers—Allis-Chalmers Mfg. Co. 2, 36 in. diam. by 14 ft., 1600 sq. ft., 2-pass, surface with auxiliaries.

Traveling Water Screen — Stephens-Adamson Mfg. Co.

Vibration Tachometers—James G. Biddle Co. Frahm type. Used on turbines.

Vacuum Gages — Taylor Instrument Cos. 2-mercury column type.

Transformers — General Electric Co. 3, 100 kv-a. for house motors and lighting.

Motors—Allis-Chalmers Mfg. Co. 3—10-hp. for f.d. fans; 3—20-hp. for i.d. fans; 1—15-hp. for elevator; 1—40-hp. for drag line; 2—100-hp. for boiler feedpumps; 1—30-hp. with Texrope drive for ashpit pump; 1—2-hp. for conveyor; 1—20-hp. for distributor; 2—10-hp. for house pumps; 1—1-hp. for screen house; 1—25-hp. for exciter set; 2—5-hp. for condensate pumps. All 220 v. 3-ph.

Motor-Generator Sets—Allis-Chalmers Mfg. Co. 1, spare exciter, 25-hp. a.c. motor, 15-kw., d.c. generator 125 v.; 1-kw. set, a.c. motor to d.c. generator 15 amp. 140 v. full load, for charging storage battery.

Storage Battery—Electric Storage Battery Co. Exide, 60 cells, 120 v., 72 hr. capacity, 232 amp. hr.

Switchgear and Switchboards—Allis-Chalmers Mfg. Co. Vertical lift, metal clad, panels and auxiliaries.

Motor Controls—Cutler-Hammer, Inc.

Electrical Instruments—Allis-Chalmers Mfg. Co. Esterline-Angus Co. Westinghouse Elec. & Mfg. Co.

Conduit—Johns-Manville. Transite.

Piping—Midwest Piping & Supply Co. and Midland Pipe & Supply Co. Welded except at special joints.

Valves—Lunkenheimer Co. and Walworth Mfg. Co. For steam and water.

Pipe Fittings—Walworth Mfg. Co. and Crane Co.

Steam Traps — Armstrong Machine Works.

Pipe Insulation—Owens-Corning Fiberglas Corp. Fiberglas and Hi Temp.

Boiler Insulation—Johns-Manville.

Unit Heaters—Ilg Electric Ventilating Co. Space heating in turbine room.

Crane—Whiting Corp. Traveling, serves turbine room.

Stairs and Grating—Standard Steel Spring Co. Gary Welded.

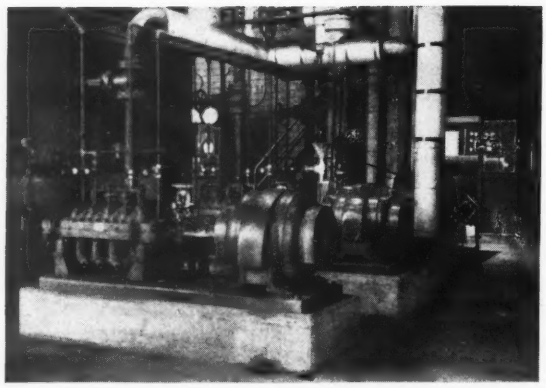


Fig. 7. (Left) Three boiler feedpumps are installed, two motor and one turbine driven

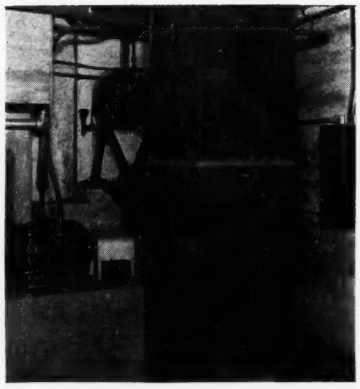


Fig. 8 (Right). Each boiler is provided with a forced draft fan of this type which has intake dampers operated by the combustion control system

extracted steam at 150 psi. to be used in the mill for drying and other industrial purposes. They are served by 2-pass surface condensers with 1600 sq. ft. of condensing surface, the circulating water being supplied by three pumps, two of which are motor driven and one by a steam turbine. These as previously stated take water through a traveling screen from a nearby pond. The return circulating water, in winter, is delivered to the pumps used for the hydraulic mining operation. When not needed for warming purposes, the water is returned to another part of the pond from which it was taken or if ice in the pond interferes with the suction, the tempering water is shortcircuited through a section of the cooling pond.

Electrical System

A full set of electrical instruments and switches, including automatic synchronizing instruments, are mounted on the metal-clad switchboard and were furnished by Allis-Chalmers Co. For emergency switching and lighting use, a 60 cell Exide storage battery is provided which operates at 120 v. and has a 72 hr. capacity of 232 amp. hr. or an 8 hr. capacity of 160 amp. hr., and charging is automatically done by a 1-kw. motor-generator set during normal operation.

Electric current is generated at 2300 v., 3-ph., 60 cycles. The main bus is carried at this voltage, the current being delivered from the generators through oil circuit breakers and is used for driving air compressors and the 500-hp. synchronous motor driven mining and jetting pumps.

For station service a ring system of wiring is employed for which Transite conduit is used enclosing small wires that burn out in case of insulation trouble. This circuit is fed at three widely separated points through three 100-kv-a. 3-ph. transformers that reduce the voltage from 2300 to 208 v., 4-wire. Two of these get their current directly from the generator leads while the third is fed from the 2300-v. bus. Interlocking controls are provided between the generator oil circuit breakers and the air breakers on the low-voltage side of the transformers. This ring system of wiring thus permits isolating one small section in case of trouble, or for other reasons, and is thus a provision against a complete shutdown.

Station motors are of the induction type and are protected by circuit breakers and push button controls where needed. For emergency purposes, outside electric connection is made with the plant of the Libbey-Owens-Ford Glass Co., which is located in the vicinity.

In the organization of the Ottawa Silica Co., G. A. Thornton is vice president and general manager, Wayne B. Gyger, superintendent, has charge of plant operations, and E. C. Carter as chief engineer is responsible for the power plant operation and maintenance. The design and construction of this plant was handled by Laramore and Douglass, Inc., Consulting Engineers of Chicago.

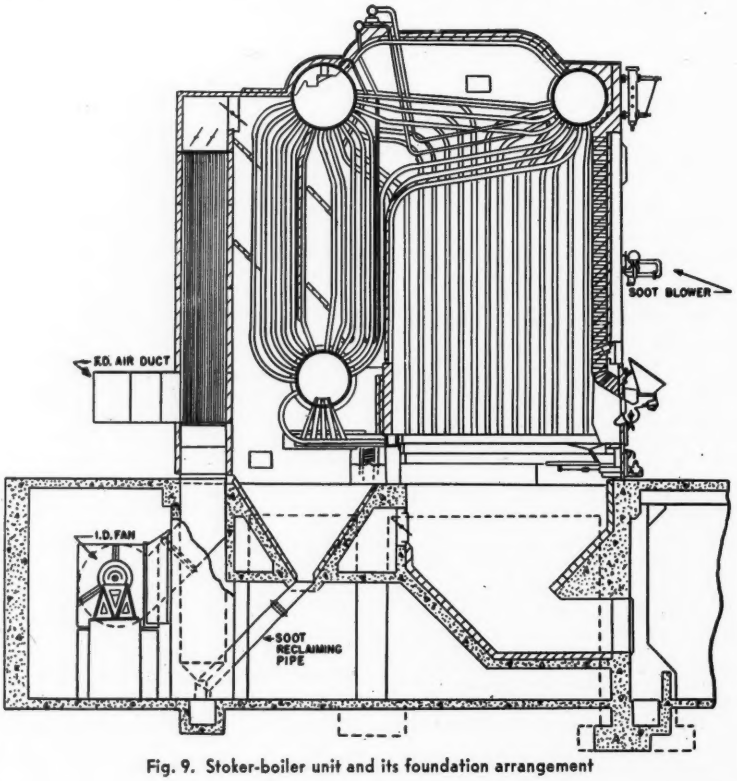


Fig. 9. Stoker-boiler unit and its foundation arrangement

FUEL OIL HEATERS

Part II of an article dealing with the selection of fuel oil heaters. Part III covers practical aspects of operation and maintenance

By E. G. ROBERTS*

GENERAL specifications for a fuel oil heater should include the type of heater and materials; indication of whether the oil passage is inside or outside of the tubes; heat transfer rate for the specified oil for maximum flow and heated through the desired temperature range; heating medium with working steam pressure and temperature, (or proper units if water or electricity is used); type of flow, (straight or approximate counterflow); and, finally the test pressure for oil and steam sides.

When the actual heater is obtained, a graph or table should be made showing the relationship between the following factors; overall heat transfer coefficient; oil quantities and steam quantities per hour; pressure drop; and, oil velocity. The balance between the fuel oil exit temperatures for maximum and normal load conditions may be obtained through the careful selection of the heater. This chart can be used successfully as a guide to fuel oil heater load and heating requirements during regular operation based on maximum peak and normal load requirements of the fuel firing equipment.

The commercial types of oil preheaters may be listed as in Table I. Each type has its own characteristics, advantages and disadvantages. Some heaters have only low cost and simple design in their favor. The standard type involves a higher first cost, but this is offset by better performance efficiency in operation. There are a few heater types which provide complex internal construction. The resistance to oil passages is high, and in general operating costs are much higher in this type.

Some points to consider in comparing the merits of any single heater are: medium or low cost and ease of installation; range of load requirements that can be handled; compactness and space requirements; accessibility for inspection and cleaning; ease of replacing parts at low cost; low cost of operation; durability; and, arrangements for safety in operation.

The shell and tube heater, with straight or U-bend tubes is a common form. The tubes can be cleaned without making any pipe openings. These heaters are constructed of rolled steel shells and seamless steel tubes especially where high working pressures are used. Cast iron oil distribution heads are used up to 150 lb. working pressure, cast or rolled steel for higher pressures. Hydrostatic test for pressures usually 50 per cent above the working pressure is specified for standard design. The tubular heater has a steel shell with steel flanges and connections electric arc welded. Steel tubes are tied into a steel header with the free ends swaged. Steam tubes installed in the oil heater tubes are of copper.

In selecting the oil heater therefore check the following items for they control the satisfactory conditions of operation:

1. Pressures, both working and test, based on A.S.M.E. code requirements.

2. Numer of passes, and tubes per pass in an arrangement to obtain the needed effective heating area. Simplicity is the keynote for good operation and ease of cleaning.

Table I. Commercial types of fuel oil heaters

- I. Shell and Tube Heaters
  - A. Heating Medium in Shell
    1. Straight tube, single and multi-pass
    2. U-tube
    3. Spiral Coil
  - B. Heating Medium in Tubes
    1. Copper tube inside steel tube swaged at floating end
    2. Straight tube, multipass, baffles
    3. U-tube, multipass, baffles
    4. Spiral Coil
- II. Double Pipe Heaters
  - A. One pipe inside another, concentric
  - B. One pipe under another; the two pipes insulated together
- III. Storage Tank Heaters
  - A. Conventional shell and tube heater, one or two tube passes. Suction type low resistance
  - B. Suction bell, finned heating element
  - C. Copper coil
- IV. Electric Heaters
  - A. Coil type, wound around pipe.
  - B. Heater element placed inside pipe

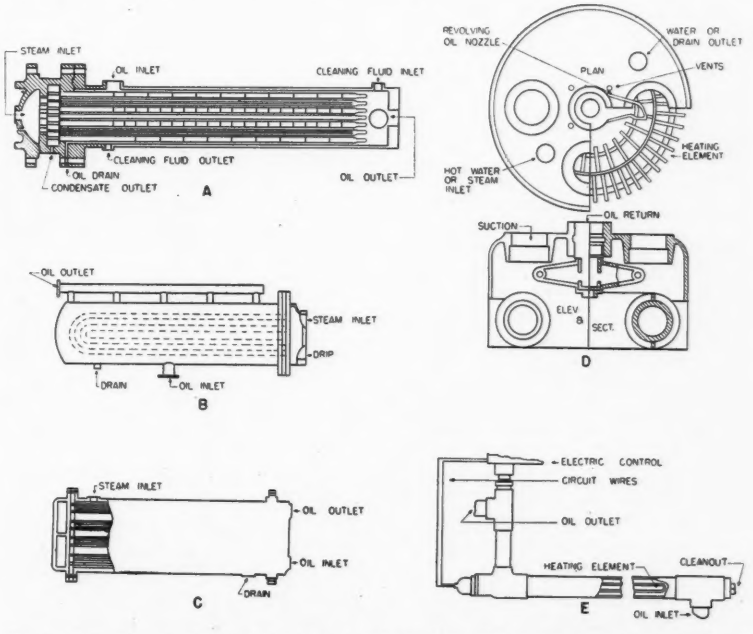


Fig. 6. Several types of fuel oil heaters. A, tubular type with copper steam tubes inside of steel oil heating tubes. B, two pass U-bend heater. C, a four pass shell and tube heater. D, plan and section of a suction bell heater usually placed at the lower levels of a storage tank. E, an electric heater with the elements placed in a pipe and the oil temeprature controlled thermostatically

*Formerly Associate Engineer, Power Div., Federal Works Agency, Washington, D. C. Part I appeared on page 67 of the March 1942 issue.

3. Actual amount of effective heating surface as guaranteed.

4. Entrance and exit oil temperatures at maximum load, and at other loads if possible. Test data should also include pumping requirements and steam consumption.

5. Ample heater reserve capacity, sized for the total oil pumped with a bypass connection to return the surplus to the storage tank.

6. Diameter of tubes should not be so small as to create high friction loss or offer cleaning difficulties, and, not unduly large so to lower heat transfer efficiency.

7. Safety devices to guard against excessive pressures and control of steam supply.

Design requirements call for fuel oil heating capacity at the maximum rate of flow based on the specifications of the fuel oil to be used, whether it be cracked residue, Bunker C, or the higher grades. Considering steam as the heating agent, the number of tubes per pass, the size of the tubes, and the number of passes must be determined from the effective heating surface required, the velocity and pressure drop through the tubes, and the overall dimensions. The overall coefficient of heat transfer range should be selected with consideration of the type of heater as well as the fuel oil and steam quantities flowing between the given temperature limits.

In the tubes, the continuous heating of the oil to higher temperature reduces the oil "heaviness" until somewhere near the end of the tube passage turbulent flow may occur. The Reynolds' Number[3] of 2200 approximates this flow condition. The heavier or more viscous the oils, the higher the Reynolds' Number at which the change to turbulent flow takes place.

The velocity for a value of Re = 2200 can be calculated readily. Taking a value of 150 S.S.U., the optimum condition for thorough atomization, and various tube sizes this is done as shown in Table II. The table is based on a particular oil heater, and it is possible to show that for turbulent flow to occur, the oil velocities must exceed those given. It is evident that a change to turbulent flow is more likely to occur in the large tubes if it occurs at all. Small tube diameters preclude any possibility of these velocities being attained because of the excessive pressure drops.

Table II. For the conditions specified in the article, velocities shown are below the turbulent region

Tube size, in.	½	¾	1	1¼	1½	2
Velocity, ft. per sec.	13.4	10.1	7.9	6.0	5.2	4.0
Flow, lb. per hr. per tube	5700	7450	9560	12,570	14,670	18,820
Flow, gal. per hr. per tube	760	994	1276	1675	1960	2510

Table III. Specific references, including the tables and certain values in the text are obtained from studies made on a Paracoil No. 8-C multi-pass tubular heater capable of heating 8000 lb. per hr. of 14-16 deg. Bé. oil from 95 to 275 deg. F. The design is based on outside tube surface with steam at 125 lb. ga. and 50 deg. F. superheat with the heater tested hydrostatically to 500 lb. on the oil side and 400 lb. on the steam side. This heater's characteristics are given below

Oil Flow Lb. per hr.	Overall Heat Trans. Coef. B.t.u./sq.ft./deg.F./hr.	Lb. of Steam per hr.	Oil Velocity Ft. per sec.	Pressure Drop Lb. per sq. in.
8000[1]	86.5	795	4.35	25.0
7000	79.5	695	3.80	19.5
6000	71.5	595	3.25	15.0
5000	62.5	495	2.67	11.0
4000[2]	50.0	395	2.10	7.5
3500	45.5	345	1.85	6.0

[1]Maximum load. [2]Normal load one boiler.

Turbulence

Conditions of turbulence within the large tubes can be obtained within narrow limits, near the heater discharge with maximum flow of oil. Turbulent flow of oil creates high-pressure drops[4], thus requiring many tubes with short passages, the number depending on the size and the pressure drop allowable. It is possible that the advance of fuel oil burning will demand two stage heaters, where performance and heat requirements for heat balance are important. The assumption may be definitely made that heavy fuel oil in preheaters will have streamline flow characteristics through most of the tube passage except under extremely high-pressure drops. The necessary viscosity of 150 S.S.U. can be obtained under moderate heating rates with velocities of 2 to 3 ft. per sec. in 1¼ and 2 in. tubes.

Temperature, and hence the viscosity of the oil is controlled by the rate of heat transfer for freely flowing liquid fuel oil and occurs only after the oil temperature rise and with correspondingly low viscosity readings. Proper design of the fuel oil heater takes account of all these factors. Whether turbulence is attained to improve heater performance is not important, more heat is always available.

Heater Selection

In preparation for proper evaluation of the heater requirements, the first move is a complete record of the fuel oil specifications. Fuel oil prices, along with other factors, which may in time demand that individuals responsible for economy and efficiency in operation in the land and marine power plants give full consideration of cracked residue, Bunker C and the higher grades, with due regard for burning characteristics of each type. Varying physical and chemical characteristics of the oils, and their varying specifications, require close attention in the design and selection of the heater and other handling and preparation equipment. The possibility of the burning of fuel oils from different sources, varying distillates, different classification or grade in a given heater certainly requires a careful study of the heater char-

[3]Reynolds Number, abbreviated R_e is a function of pipe size, velocity and viscosity. For pipe friction and flow it is commonly written as

$$R_e = D V p \div u$$

where, in English units, D is the inside pipe diameter in ft.; V, the velocity in ft. per sec.; p, the density in lb. per cu. ft.; and u, the viscosity in lb./sec. ft.

This Modulus (a quantity that measures some function or effect) is one of a group of several so-called dimensionless units widely used in dimensional analysis, heat transfer, pipe friction, etc. They are dimensionless because when dimensions are substituted in the formula they all cancel out. The calculated values are, therefore, numerically the same regardless of the system of units used as long as the units are consistent throughout.

The number is named after Osborne Reynolds, an early English investigator, who made use of it in expressing the results of his critical velocity experiments. By means of a fine stream of dye in a glass tube of flowing water he determined the transition point between streamline (also called viscous or laminar), and turbulent flow. The transition point was clearly indicated by a break down or diffusion of the dye system. He found it was influenced by many factors, including pipe diameter, viscosity and velocity. The critical point is approximately at a value of R_e = 2200 (see Fig. 1). Later investigations show that in circular pipe it varies from a value of about 2100 to 3100. There is considerable overlapping between streamline and turbulent flow depending on conditions. Thus when the velocity is increased slowly, streamline flow may persist until a value of R_e of well above 3100. When the velocity is gradually decreased, turbulent flow continues down to a value of about 1200.

[4]Hamilton, J. E., Marine Engineering Shipping Review, August, 1935

acteristics under fixed operating conditions for each oil specification. Once a heater has been selected on the basis of a particular fuel oil characteristics this should be strictly adhered to for the best performance from the heater.

The maximum normal rate at which the oil will be burned must next be determined; these values are usually given in pounds per burner per hour, less frequently in pounds of oil per square foot of boiler heating surface per hour. Select the type of burner, mechanical or steam atomizing burner, depending mainly on the steam load requirements and range of load fluctuation, the comparative economics of first cost, and the cost of operation.

(To be concluded)

Modern Wick Lubrication

BY VERNON HUFF*

MODERN machinery is built for economical operation and upkeep. It is designed with engineered precision and condition favorable to proper lubrication. In extreme operating conditions, it sometimes becomes impossible to maintain proper lubrication for any appreciable period of time. In these conditions wear is inevitable and can be controlled only by the ability of the lubricant, and the frequence of its application. Often by developing additional application methods after machines are installed and operating, lubrication can be greatly improved, especially in the heavy service types and extreme operating conditions.

In most industrial plants there are many machines using light bodied oils, which are lubricated by means of wick feed and drop feed cups. It is not generally known that heavy bodied oils will also operate efficiently in these methods of application, not known that is, to the operating personnel of plants. The wick feed cup is especially adaptable to the viscous fluids. The various types of wick feeds are similar, in that they all employ the capillary or absorbent principle of a porous material, wool yarn, cotton, etc.

When wool yarn or cotton material is submerged in oil the tendency of the oil is to climb upward through the porous material. This absorbent action is similar to the kerosene wick in a kerosene lamp. The action is dependent upon the characteristics of the liquid known as surface tension, and on the nature of the absorbent material or wick.

In a wick of superior quality, the absorbent power of the material will raise the oil 2 in. or more, the greater the height the less oil is raised by absorption. The most common type of wick feed cup consists of a metal vessel containing a tube through its vertical center. This tube connects with a pipe under the cup through which the oil is fed. The oil reservoir is contained inside the cup around the center tube. Oil is placed in this reservoir and the wicks submerged in it, extend upward and down into the tube. They reach to a depth in the tube just short of its length or about 3 in. The flow of oil is controlled by the number of wicks or strands placed in the cup and tube, each strand being capable of handling a specific amount of oil per hour. Strands may be separated by threads to effect closer control of the feed. The cups are usually made of pressed steel and will withstand considerable abuse.

The installation of the wick feed cup is determined by the service requirements. Their application to bearings, gears, eccentrics, etc., are numerous in many plants and on many types of machines. The resultant savings in oil costs make them highly beneficial. In service where operating conditions are subject to dust and dirt such as paper mills, wood working plants, cement plants, the wick feed cup method of application is advantageous for the wicks act as a filter for the oil. Regardless of the amount of impurities or their kind, only the oil travels through the wick to the part to be lubricated.

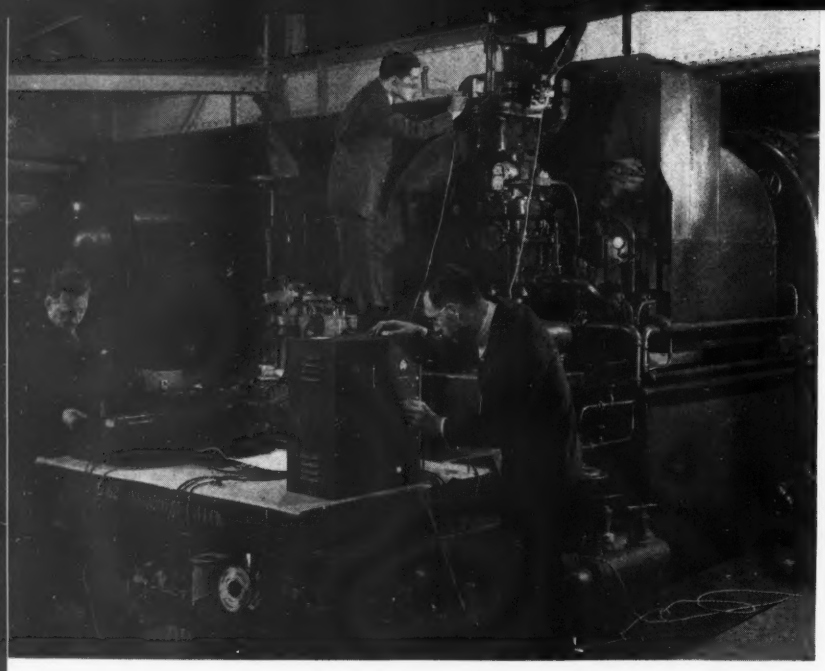
Wick feeds are especially recommended for service in bearings and on gears where frequent application is necessary but required only in a limited quantity. Due to their reservoir capacity, they also offer an appreciable savings in time and labor when installed at points on machinery requiring frequent hand oiling or to replace small oilers which require frequent refilling. The 4-oz. cup in average service will hold sufficient oil for 8 to 12 hr. operation. This depends of course on the lubricated part and the rate of feed.

Summary

In summary, proper lubrication may be considered by the manner in which it takes into consideration: the type of machine, the part, bearing, gear, or cylinder, the design, material and finish; the protection of working surfaces from wear and rust, operating conditions, loads, speeds, and temperatures; the presence of foreign matter such as dust and moisture. Lubrication also means proper application and an adequate supply of oil to the operating parts. It requires the selection of a lubricant best suited to the condition for reducing friction and wear to the lowest possible point. The results and benefits will be lower power costs, greater labor savings, increased machine life, and the ultimate in maintenance economy.

Types of lubricants and their characteristics as discussed in these articles may be had from any supplier of industrial lubricants. Most suppliers maintain an engineering service, available to industrial plants at no charge for the service. When in doubt regarding the proper lubricant for a new machine or a troublesome condition, it is recommended that a request be made to your supplier for a field engineer to assist in correcting the condition.

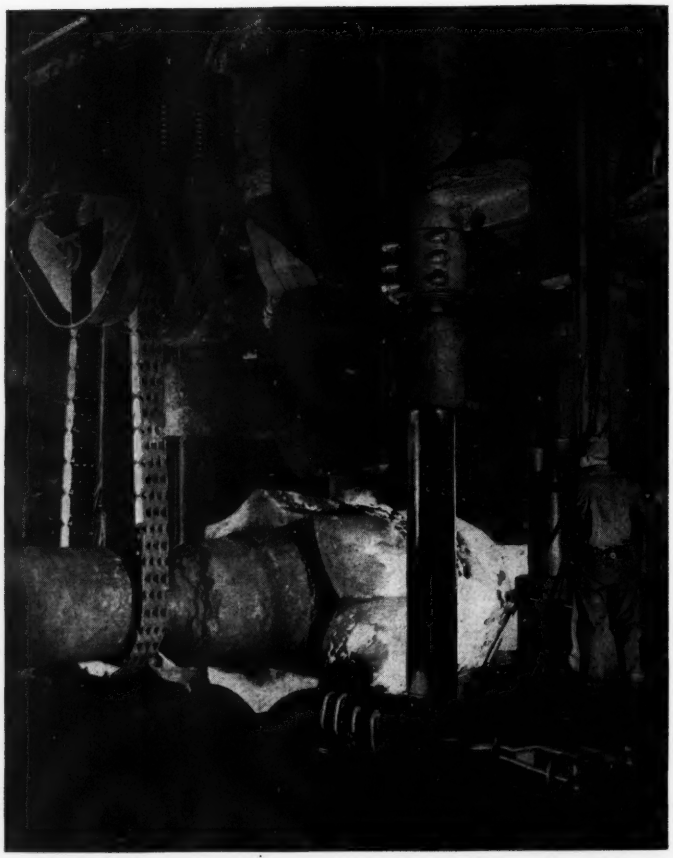
*This is the fourth and concluding article of a series dealing with practical lubricating problems. Part I on bearings of all types appeared on page 56 of the April, 1941 issue and contained specific recommendations for oil properties and specifications for different services. Part II, which appeared on page 69 of the June, 1941 issue, covered steam engine, Diesel engine and air compressor cylinder lubrication. Part III on gears, gear friction and gear lubrication appeared on page 102 of the October, 1941 issue.

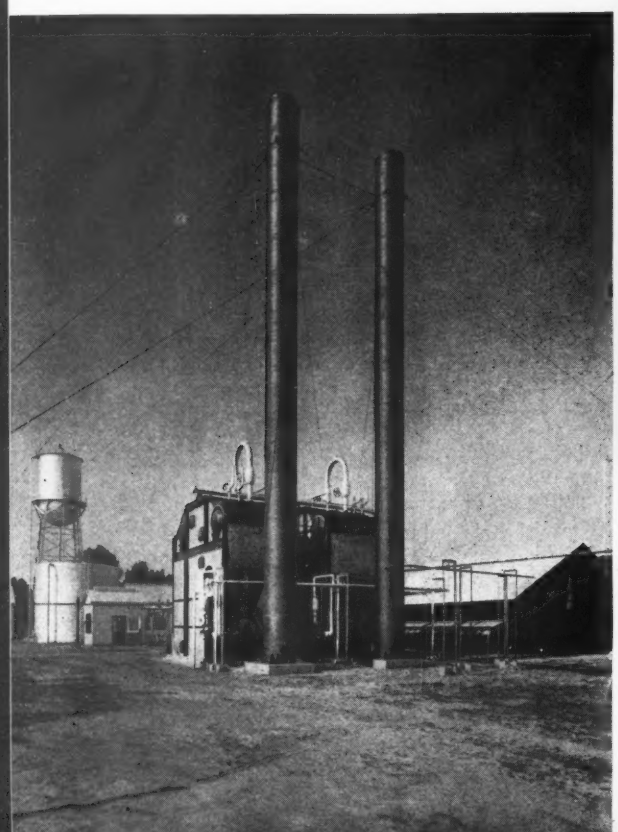


PICTURES

(Left) A new tool for studying governor performance. A scene in the Westinghouse shops showing a turbine governor being tested by means of a new instrument. Several special fact-finding instruments are placed at strategic spots about the control system and their information relayed electrically to an oscillograph for simultaneous record. One is the valve travel recorder, in which the movement of the valve is translated into proportional electrical voltage by a magnetic strain gage. Other instruments simultaneously record oil pressures involved in the control system. These instruments are applicable to all types of turbine governors

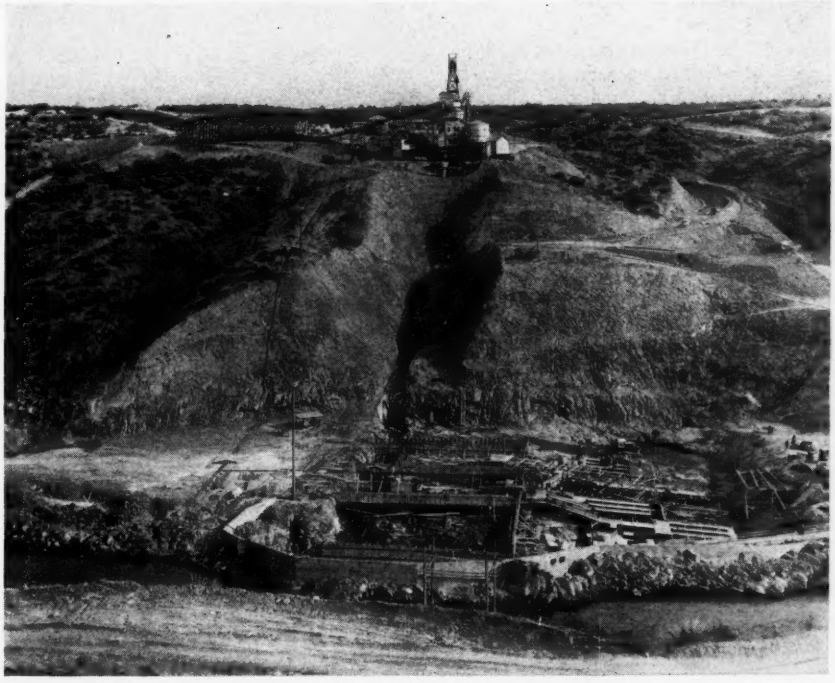
At the right is shown a mammoth hydraulic press capable of exerting a force of 6,000,000 lb. forging a spindle for a war-service turbine at the Milwaukee, Wisconsin, plant of the Allis-Chalmers Manufacturing Co. This spindle is one of more than 3,000,000-hp. in steam and gas turbines, the vast majority of which are vital to defense industries, now in production at the Allis-Chalmers works. This is the first operation in the production of a modern steel turbine shaft



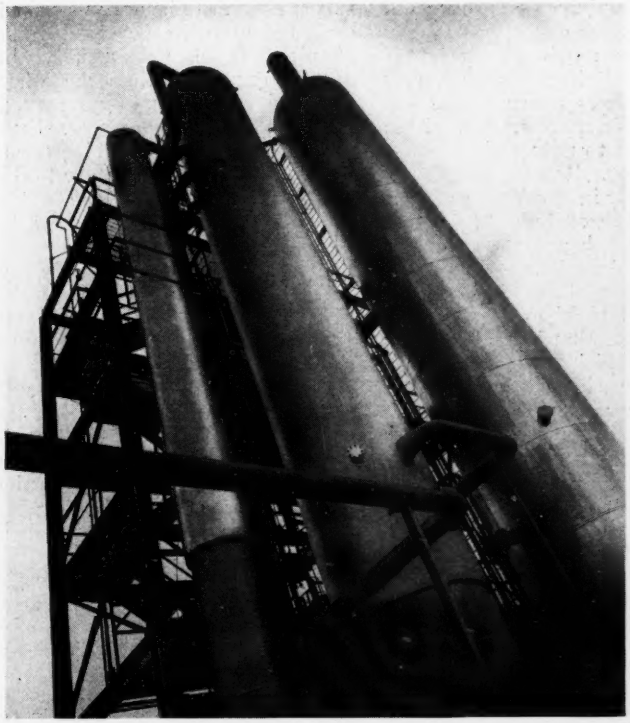


(Left) A view of an unusual boiler plant. At the Cotton Valley Operators Association, Invincible Spur, La., two 236-hp. Union Iron Works, boilers are installed in the open. These boilers are used with "recycling plants" in the oil refineries. They take the initial oil well gas, then pump it back through the wells again to give it added richness. Note the neat and simple arrangement of the stacks and the induced draft fans between stacks and boilers

# of Engineering Interest



(Left) Within 60 days after the Bureau of Reclamation awarded the contract for Keswick Dam and Power Plant on the Central Valley project in California, construction was well under way as is shown by this view of the concrete mixing plant and foundation of the left abutment. Keswick Dam's 75,000-kw. capacity power plant will supplement Shasta Dam's 375,000-kw. capacity in 1943 when war production will be straining facilities to the utmost. The first bucket of concrete was placed under the direction of the Bureau of Reclamation by the Atkinson Kier Co. November 14, 1941



(Above) What is believed to be the largest solvent recovery unit in the Akron, Ohio, area is now being operated by the B. F. Goodrich Co. at its recently opened Koroseal spreading plant. The photograph shows the three towers comprising the unit. The largest, at the right, 78 ft. high, weighs 130,00 lb.

(Below) A view in the General Electric Co. shops showing a portable million-volt X-ray machine in use in the examination of a large turbine casting. Such inspection equipment is becoming ever more important as the size and cost of pieces increase

Deposits which form on the nozzles and buckets of turbines are of three general types and cause loss in both turbine capacity and efficiency. For rough calculations the decrease in efficiency can be taken as 1 per cent for each 1 per cent weighed average increase in shell pressure. Soluble deposits may be washed off but nonsoluble tenacious types, at the present time, must be sandblasted. Authorities disagree as to how these deposits are laid down but the author tells the Engineers' Society of W. Pa. that the sodium sulphate treatment appears to be effective and that careful plant operators working with a competent chemist can, in most cases, affect an appreciable reduction in the amount of the deposits

By B. O. BUCKLAND
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How to Remove TURBINE DEPOSITS

WHEN SALT deposits accumulate on the nozzles and buckets of a turbine, the steam-flow areas are reduced, the nozzle and bucket surfaces are roughened, and the distribution of energy in the turbine stages is disturbed by the presence of the deposit. These conditions result in a reduction in turbine capacity and efficiency.

A great deal of work has been done on the problem both by chemists and by boiler manufacturers. Chemists have contributed by providing methods of boiler-water treatment to reduce carryover and to minimize the deposits that may result from a given amount of carryover. Boiler manufacturers have provided steam washers and improved water separators within their boilers to reduce the amount of carryover. Results of this research work in the hands of persistent and careful plant operators can accomplish a great reduction in turbine deposits.

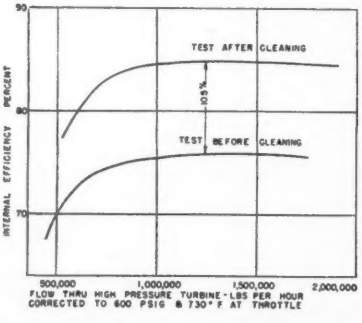


Fig. 1. Improvement in efficiency of one high-pressure turbine due to removal of deposit from nozzles and buckets. Reduction in shell pressure after cleaning ranged from about 31 per cent in the first eight stages down to about 1 per cent in the next to the last stage

In spite of this work records of some 30 turbines tested since 1935 indicate that half of the turbines on which acceptance tests were made showed evidence of deposit. For purposes of classification a turbine of this group was considered dirty if four or more stages showed deposits of 10 mils thickness or greater. Turbines considered dirty ranged from this minimum to a maximum deposit similar to that shown in Fig. 1.

Appearance and Location in the Turbine

Most blade deposits can be classified, according to their general appearance, into (1), friable and somewhat soft; (2) sparkling and silvery; and (3) smooth hard film.

The first of these ranges in color from pinkish white to a tan and is sometimes deliquescent. It is soft enough to be easily crushed and flaked off the blades in chunks. It occurs usually in greater quantities than the other two and can be readily removed by a jet of air and water. Usually, it occurs in the turbine from, and including, the first stake to the dew point in the turbine. This type of deposit is illustrated in Fig. 1.

The second kind is silvery gray and often sparkles in the light like new snow. It is hard and granular and clings tenaciously to the blading. Soaking in water or subjecting it to jets of air and water have little or no effect. It occurs from the third or fourth stage of a 900 deg. F. turbine to a point in the turbine at which the temperature is 400 to 500 deg. F., and sometimes, almost to the dew point.

The proportion of this deposit which is formed on the surfaces other than the nozzles and buckets, such as wheel sides, diaphragm sides, etc., is greater than in the case of the other two kinds of deposit. Often sufficient deposit occurs on the diaphragm sides to give them the same sparkling appearance as the blading.

The third kind of deposit, Fig. 3, is a hard, relatively smooth, red or dark brown film streaked with

white opaque. Very distinct traces of flow lines in the boundary layers of the nozzle and bucket passage are left in this deposit.

Reduction in Efficiency and Capacity

The accumulation has three effects which are measurable when the turbine is assembled and in operation: (1) increase in shell pressure; (2) reduction in efficiency; (3) reduction in capacity. The reduction in capacity is the result of a combination of the reduction in flow and efficiency while the reduction in flow is largely dependent on where the deposits occur. Deposits in the first and early stages of a turbine reduce the flow to a greater amount than deposits in the later stages, but the effect on efficiency is probably independent of the location for a particular amount and extent of deposit.

Effects of deposits on the efficiency has been measured in a number of instances.* In one case a test was made with the turbine dirty, after which it was opened and cleaned and retested. The change in efficiency is shown by Fig. 2. The per cent increase in shell pressure averaged by weighing it with the energy at the stage in which it occurred, gave a change in efficiency of about 0.6 per cent for each 1 per cent change in this weighted average shell pressure.

For very rough calculations, the efficiency can be regarded as decreasing about 1 per cent for each weighted average 1 per cent change in shell pressure. For cases where the turbine is designed to handle small volume flow and the deposit extends to the exhaust, the decrease in efficiency will be closer to 1½ per cent, and for cases where the turbine is designed to handle large volume flow and the amount of the deposit is very great, the figure will be closer to ½ per cent.*

Means of Removing Deposits

While the weighted average change in shell pressure is not always a good measure of the change in performance, in cases where the deposit is confined to the early stages, it is a convenient measure of the amount of the deposit. In cases where the deposit extends to the exhaust end of the turbine, as it often does in topping units, the average per cent change in shell pressure does not directly measure the amount of the dirt because the exhaust pressure is held fixed, but, the change in effective passage area can be calculated from a given change in the pressure distribution.*

Deposits can be removed either by cleaning after disassembly of the parts or by washing without disassembly. When the deposit is more or less soluble, cleaning during overhaul can be readily accomplished by subjecting the nozzles and buckets to a strong jet of water and compressed air.

When the deposits are insoluble and tenacious, as are silica deposits, the most satisfactory method of cleaning is to blast the blades with a jet of air into which fly-ash is fed in amounts similar to the amount of sand used in sandblasting.

Ash used need not be as fine as that which floats out of the stack with the flue gases. That found in the base of the stack is satisfactory, although it may be in the form of shells and bubbles of fairly large size. Even river silt has been used with satisfactory results. Normal sand cuts too fast and leaves scratches, but fly-ash removes the deposit and leaves a smooth satiny finish on the blading.

In some cases when the ash contains unburned carbon, a high graphite-like polish is obtained and it may be possible that this type of polish is beneficial in preventing deposits from sticking to the blades, at least for a short time.

Various mechanical arrangements have been used for fly-ashing, ranging from the use of a concrete-gun outfit to a home-made air-jet injector with the injector suction hose held in a bucket of fly-ash. Flyashing is a messy procedure and is most conveniently done outdoors. However, if the nozzle has a narrow annular slit (surrounding the air jet) into which water is fed during the use of the jet, most of the dust can be trapped with this shell of water. If the job must be done indoors, a hood can be built over the parts and an exhaust connection made to outdoors.

Washing

When the deposits are sufficiently water soluble, the turbine may be cleaned by washing without disassembly. All sorts of schemes for washing have been tried, with varying degrees of success. Some turbines have been washed by shutting down and slowly rolling the rotor with the lower half shell full of water.

Some have been washed by running the turbine at no load and shutting off the fire in the boiler, thus operating the turbine for a short period with saturated steam. In a number of cases, merely shutting down the turbine over a week end has resulted in an increase of capacity, presumably because during the stopping and starting operations the turbine nozzles and buckets are subjected to moist steam or water vapor.

However, the most satisfactory method of washing, in the writer's opinion, is to set up the following apparatus and procedure: A nozzle of the proper size to pass sufficient steam flow at normal boiler pressure to run the turbine at a little more than one-fourth speed is provided in a line which bypasses the boiler stop valve and empties into the turbine inlet pipe ahead of the throttle and strainer.

There is also provided a second nozzle designed to pass a flow of water somewhat more than sufficient to completely desuperheat the steam delivered by the first nozzle. The second nozzle is arranged to discharge into the bypass line at the point of exit of

Fig. 2. Typical deposit on the nozzle partitions of a turbine. This scale is soluble and the analysis is, in per cent: Sodium silicate, 27.70; ferrous sulphate, 1.58; sodium sulphate, 3.17; sodium phosphate, 1.20; sodium chloride, 1.58; magnesium chloride, 0.57; sodium hydroxide, 18.11; and sodium carbonate, 12.68. The photograph at the top of this page shows the deposits on the buckets of the same turbine

* This subject, treated but briefly here to indicate the importance of deposits on performance, will be developed more fully from representative acceptance test data in an article the author is now preparing on the "Effect of Deposits on Turbine Capacity and Efficiency."

the first nozzle. A recording temperature-indicating instrument is provided with its bulb or thermocouple located in the turbine inlet pipe, as far as possible from the point at which the bypass nozzle empties into this pipe, but ahead of the throttle and strainer. The bulb should preferably be located on the underside of the pipe.

Rate of Temperature Reduction Is Important

With this apparatus or its equivalent, the washing procedure is as follows: The turbine is unloaded and reduced in speed to about one-fourth or one-fifth normal, after which the flow required to maintain this speed is transferred to the bypass washing nozzle by shutting the boiler stop valve and opening the bypass nozzle line.

Control of turbine speed is then transferred from the turbine throttle or control valves to the valve in the bypass line by opening the turbine throttle and control valves wide and adjusting the flow to hold the desired speed. This assists in carrying the moisture by keeping the velocity high and prevents superheating due to throttling.

Feedwater is then admitted to the bypass line in such an amount as to reduce the steam temperature to the turbine at a rate not faster than 100 deg. F. per hr. until the saturation point is reached. The pressures and pressure drops in the washing nozzles are noted, and the feedwater flow is increased sufficiently to produce approximately 1 or 2 per cent moisture in the steam. The turbine is run under these conditions until it is judged clean on the basis of previous experience or from the conductivity of the condensate. After washing, the procedure is reversed until the turbine is on the line, care being taken not to exceed a reasonable rate of temperature rise, such as 100 deg. F. per hr.

Washing of turbines with fluids other than steam and water is possible and in one case two of three badly plugged 350-hp. turbines were washed with an inhibited hydrochloric acid solution. The composition of the scale was approximately one-fourth silica and three-fourths carbonate. The process was not entirely successful and the third turbine was cleaned by sandblasting.

In the other case the washing of turbines at standstill with 10 to 12 per cent sodium hydroxide solution and steam is reported to have been tried in Germany. This was for the purpose of removing insoluble silica deposits, but it is not clear from the report what degree of success was attained.

Effective Prevention

Whatever the true explanation of how turbine deposits are laid down, the most effective method of preventing them, within the writer's experience, seems to be the sodium sulphate treatment suggested by Straub. This is the method that the State Line Plant of the Chicago District Electric Generating Corp. has employed. A brief outline of the experience which this plant has had in preventing deposit in turbines is contained in the following quotation from a communication to the writer by Mr. Frank Umbehocker, plant engineer.

"From 1930 to 1934 we attempted to control turbine-blade deposits by reducing carryover mainly through reducing the dissolved solids in the boiler water. Even though we limited our boiler water concentration to less than 350 p.p.m. and had steam with a specific resistance of 1,000,000 ohms or more (less than 0.5 p.p.m. carryover) we still had trouble with fouling. (See Fig. 1.)

"We then increased the periods between washing of the high-pressure turbine. Later we eliminated washing completely by careful maintenance of a 5:1 ratio of Na_2SO_4 to NaOH. We found it necessary to check boiler waters daily, whereas in 1935 it was being done once a week.

"We also found that the usual turbidity method of sulfate determination was very unreliable, giving errors as high as 100 per cent. This was one reason why we did not eliminate washing completely until 1937. For a time we determined the sulfate gravimetrically to insure the 5:1 ratio, but are now using the di-sodium tetrahydroxy-quinone method which is quite reliable."

Obviously, this or any other control practice that prevents the formation of deposits on turbine nozzles and buckets, and thus continuously provides the resulting benefits, is more valuable than a washing method that provides the benefits only periodically.

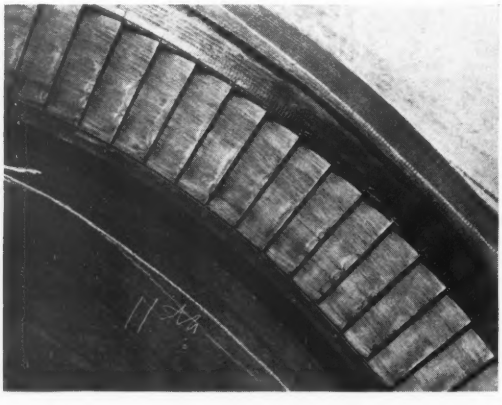


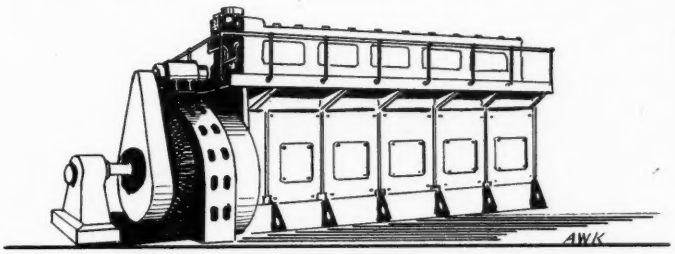
Fig. 3. An example of a hard thin film deposit on nozzle partitions. This type is insoluble and as a rule has little effect on turbine performance because it has a hard smooth surface and rarely forms in more than film thickness

BETTER WIRE DRAWING CONTROL

WIRE is drawn by pulling it through a succession of dies. Between each die is a motor-driven drum, around which the wire is snubbed and obviously the motors must always maintain the same ratios of speed, from threading at low speed to running at high speed. Ordinarily motors are supplied from a constant-voltage bus, the speeds being controlled by field rheostats positioned mechanically by the wire itself.

The George W. Prentiss Co., Holyoke, Mass., has developed a wire-drawing bench using Westinghouse variable-voltage motors with which rheostats and mechanical connections are eliminated. Once the proper field adjustments are made to each motor, they can, simply by raising the supply voltage, simultaneously be: started from standstill; operate at low speeds for threading; and, up to full running speeds, all with the speed ratios so closely maintained that tension in the wire remains constant on each side of each die. As a result of this greater mechanical and operating simplicity, wire breaks occur less frequently and starts are smoother.

Inspection Procedure For DIESEL ENGINES



BY E. R. SPENCER
Engineer, The Cooper-Bessemer Corp.
Mt. Vernon, Ohio

This is the second part of a two part article. The first part which was presented on page 70 of the February issue dealt with the inspection of the crankshaft and the main bearings. This, second part, deals with the inspection of the cylinder liners, pistons, connecting rods and the other moving parts of the engine. The article was originally presented as a paper at the A.S.M.E. meeting at Kansas City, Mo. It is reprinted here because of its importance to the operator of the classes of Diesel engines used in power plant service

THE FIRST PART of this consideration of the procedure involved in the inspection of Diesel engines dealt with the inspection and adjustment of the crankshaft and the main bearings.

The inspector should now turn his attention to determining the serviceability of the cylinder or liner (hereafter referred to as liner). Examine each liner for cracks, scores or other defects that would make it unfit for service. Measure the diameter of each liner with inside micrometers in several places near the rubber grommet or other water jacket seal rings. Often these rings will force liners out-of-round. If, after considering possible wear, the liner is found out-of-round more than two ten-thousandths inch (0.0002) per inch of diameter, it should be corrected. A complete and comprehensive record of liner wear is not only helpful, but essential to the prediction of future performance and the intelligent prosecution of a maintenance program. Each liner should therefore be accurately measured with inside micrometers and a permanent record made of the results. It is customary to take these measurements across the liner in planes parallel and perpendicular to the crank pin. The number of measurements taken will depend on how elaborate a record is desired.

For a complete picture of liner wear, however, the following schedule is recommended. Take measurement at the center of each compression ring location when in their respective extreme top position. Take four additional measurements between the lower compression ring position and the bottom of the liner. Make the first of these four measurements one-tenth the distance from the center of the bottom compression ring in its top position to the extreme lower end of the liner. The next two will be taken at twenty-five hundredths (0.25) and six-tenths (0.6) this distance respectively. A fourth measurement will be made across the liner at the extreme bottom.

Liner Wear Measurements

If the engine happens to be of the two-cycle type, care should be exercised to obtain at least one measurement near the center of the port zone. These port measurements may be in addition to the ones specified above. If records thus obtained are to be of future value, they must be so taken that a measurement in identically the same place can be procured at a later date for comparison. To do this, the use of a template is suggested. Make it out of ⅛ in. by 1 in. strap iron or copper. Near one end make a right angle bend that will hook over the top of the liner. Accurately locate the position of each liner measurement desired along the longitudinal axis of this template. Drill holes at each location making them slightly larger than the inside micrometer shaft used. Scribe the top of liner so that the template can always be returned to the same position with respect to the crank pin center line.

In the past there has been no uniform way to express liner wear. Hence, the inspector has been at a loss when trying to compare his figures with those procured by others so the following terms and meanings are suggested for uniformity:

Maximum liner wear — The largest diameter found regardless of location.

Liner wear — The numerical average of the diameters perpendicular to and parallel with the crank pin. These taken at the location of the center of the top compression piston ring when in its extreme top position.

Out-of-round liner wear — "Maximum liner wear" minus the smallest diameter measured at the same height as the "maximum liner wear."

It is rather difficult to say just when a given liner is no longer serviceable. The practice of many companies, however, is to start proceedings when the liner wear has reached five thousandths inch (0.005) per inch of diameter. This

standard, of course, is based on the assumption that there are no unusual tapers or out-of-round conditions.

Remove inspection plates from water jackets and examine for scale.

Piston Pins, Bearings, etc.

There are so many types of piston pins, piston pin bearings, connecting rods and crank-pin bearings in use that it is difficult to set up an inspection procedure that will cover all. In any case, however, the clearance between moving parts should be determined. If the piston-pin bearing is of the adjustable type, the matter of compensating for wear is simple. If it is a bushing in the rod or in the piston, the job becomes one of replacement. The amount of clearance recommended for piston-pin bearings fluctuates between wide limits. For quiet operation this value varies from approximately twenty-five hundred-thousandths inch (0.00025) per inch of diameter for babbitt bearings to eight ten-thousandths inch (0.0008) for bearings made of certain types of high lead bronze. The condition of the pin should be checked for flat or out-of-round, scores, or evidence of excessive wear.

For the purpose of discussion, the alinement of a connecting rod with marine-type piston-pin and crank-pin bearings will be assumed. To thoroughly check the alinement of this assembly, it is necessary to use a surface plate, dummy pins or mandrels, micrometers or dial gages, and shafting level. With this type of bearing the bore will be checked in the same manner on both crank-pin and piston-pin bearings. Place the flat surface of the bearing shell on a surface plate. With a thin feeler gauge fifteen ten-thousandths inch (0.0015), determine any warpage, rough spots or uneven surfaces.

When the corrective measures have been applied and the bearing sets flatly on the surface plate, place a level on the shim surface. This surface should have the same slope as the surface plate. Now place the dummy pin in position and measure from each end of the pin to the surface plate with micrometer; if the bore of the bearing is parallel with the rod foot pad or flat surface, these measurements will be the same. Extreme care should be exercised to keep these misalinements as near zero as possible.

The next logical step in checking the connecting rod assembly is to see that surfaces of both connecting rod feet are smooth and true. To do this, set the rod in a vertical position on the plate and check for openings between plate and foot face. Repeat this procedure on each end of the rod. Now lay rod in a horizontal position and level the crank-end foot. In this position, the piston-pin-bearing foot should also be level. This check is made on the basis that the bearing bolt holes through the feet are symmetrical. If there is any doubt about the symmetry of the bolt holes, insert the fitted bolts and make level readings from the top of these bolts. Obviously, any misalinement in any direction must be corrected before making further investigation.

The rod feet must also be parallel to each other in a plane parallel to the piston and crank pins. Determine this by placing the rod in a vertical position with the crank pin foot resting on the surface plate. If the foot surfaces are in alinement, the distance from the surface plate to a straight edge laid across the piston pin foot will be the same on both sides of the rod. With all discrepancies corrected, assemble the rod and bearings, leaving out the shims and tighten bearing bolts sufficiently to clamp the dummy pins in place; that is, so the crank-pin dummy fits squarely in the upper half of crank pin box and the piston-pin dummy lays flatly in the lower half of the piston pin box. With these in place, level the crank-pin dummy.

Checking the Pistons

If bearings have been accurately bored, the piston-pin mandrel will also be level. Any misalinement found can usually be corrected by proper scraping of the bearing. While the parts are thus assembled, a check on previous measurements should be made. With inside micrometers, measure distance between dummy pins on each side of rod. If these distances are found to be the same, it may be assumed that the checks made with corrections to allowable tolerances have produced a well-alined assembly. Remove mandrels and assemble piston-pin bearing with proper clearance. Tighten bolts in the manner hereafter recommended for connecting-rod bearing bolts.

The piston should now be carefully checked for mechanical defects and wear. Inspect each piston-ring groove for rough and worn ring seats. Determine the ring-groove width with conventional adjustable plugs, gage and outside micrometers, or with regular plug gage and graduated feelers. With an outside micrometer, measure the diameters of the piston skirt both perpendicular and parallel to the piston pin. On the usual trunk-type piston, these two measurements should not differ more than three ten-thousandths inch (0.0003) per inch of diameter. Compare the piston skirt diameter with the minimum liner diameter.

Crankpin Adjustment

The piston and connecting rod can now be assembled and lowered into place. Assuming that the crank-pin bearing has already been inspected and fitted, the remaining problem is to adjust it to the crank pin. Assemble the bearing in place with the original shims. Place lead wires in the bearing cap similar to the outline above for main bearings. With the original clearance thus obtained, remove sufficient shims to insure desired clearance when the bearing bolts are tightened.

The tightening of connecting-rod bearing bolts has been a subject of much discussion in recent years. Some engine operators still recommend the use of so-called cheaters or sledges to place the proper tension in these bolts. The dangers in this practice are apparent. Others prefer to use shear-type wrenches.

Perhaps the most accurate method of tightening these very important bolts is by accurate measurements. The following procedure is recommended. First, assemble the bearing in the usual manner. Run the nuts down on the bolts just hand-tight. Measure the length of each bolt with a micrometer. Now tighten the bolts until further measurements indicate an elongation of a predetermined amount. It will be necessary to accurately determine the proper elongation of bolts for each size and type of engine. The length and cross-section of bolt, inertia forces and allowable unit stress will be the determining factors.

Thus, the inspection of these major moving parts of the engine has been completed. Parts thus inspected and irregularities corrected will give long hours of trouble-free service.

PUMPING PROBLEMS in the Paper Industry

Water is the paper man's conveyor belt for raw material handling, says the author before the Hydraulic Division of the A.S.M.E. and as such the problem of pumping is much more complex than when only water is involved

By M. L. EDWARDS
Weyerhaeuser Timber Co.

HYDRAULICS plays an important role in America's tenth largest industry, the manufacture of pulp and paper, which uses approximately 300 lb. of water in making each pound of paper that it produces. Pipe lines, tanks, pumps, valves and flumes act as the production line and water as the conveyor belt upon which material is handled.

Water is used as a medium for suspending pulp fiber in manufacturing processes. It distributes chemicals in the pulp and later cleanses the fiber of these chemicals. It carries away impurities. It permits screening and refining and, finally, is used to weave the tiny fibers together forming the smooth sheet of paper.

The elements of a simple paper mill arranged as a schematic diagram of water flow are shown in the drawing. The diagram is in perfect flow balance for a uniform production through the mill of 100 t. of paper in 24 hr. In order of flow, the diagram shows digester, blow pit, washer, storage tank, screens, washer, refiner (or beater), storage tank, and paper machine. The rates of flow are shown graphically by the width of the flow band. Shaded portions indicate relative density of the pulp in the water. This is known as "consistency" and percentages shown indicate consistency as the ratio of pulp to water. Thus a 3 per cent consistency would be a ratio by weight of 3 parts of dry pulp to 97 parts of water.

Pulp as a Fluid

The digester is shown delivering pulp into the blow pit at 10 per cent consistency at a rate of 150 g.p.m. This is an average figure, as cooking in the digester is a batch process and the contents of a full digester is blown into the pit at one time. Pulp is drawn at a uniform rate from the blow pit, however, and is so delivered throughout the mill.

Pulp enters the system from the digester and leaves the system at the paper drier at a flow rate of 150 g.p.m. and at a consistency of 10 per cent at both points. A flow of 6000 g.p.m. of fresh water enters the system at the top of the diagram, and 6000 g.p.m. of discarded water leaves by the sewer at the bottom. A study of hydraulic balance in a paper mill assists the operator in solving many problems of mill flow and water and stock economy.

Consistency

A thorough understanding of the nature of paper pulp as a hydraulic fluid is a cornerstone in any study of paper-mill hydraulics. The subject bears directly upon the solution of one of the paper-mill engineer's most perplexing problems, which is the flow of pulp through pumps and pipe lines. The subject will be discussed under the heads of consistency, freeness, and entrainment of air.

In a strict sense, paper pulp is the fibrous material of which paper is made. About the paper mill, however, the word "pulp" often refers to a water suspension in which the pulp fiber, by weight, is a small percentage of the aforementioned total. In other words, "pulp" refers to liquid pulp.

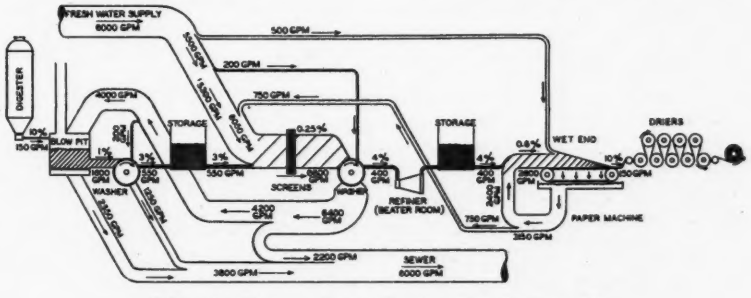
Hydraulic qualities of a pulp suspension are, of course, derived entirely from the water. Pulp is a solid. On increasing the ratio of pulp to water from low consistencies, the character of the mixture changes from that of a pure liquid, gradually assuming that of a solid as the consistency reaches the higher values.

"Freeness" is that quality of pulp which permits it to give up water by drainage. The opposite to freeness, which is "slowness," is the quality of pulp to retain water when drainage is permitted. A number of laboratory tests have been devised to measure freeness. These tests in general consist of a measurement of the quantity of water which will drain from a specified sample through a standardized wire mesh in a given time.

Freeness affects the hydraulic qualities of pulp. Lowering the freeness of a pulp decreases its solid characteristics and increases its liquid properties as already mentioned under the subject of consistency. In other words, from the standpoint of pulp flow through a pump or pipe line, 3 per cent consistency of free, unbeaten stock might have the same properties as a 4 per cent consistency of slow beaten stock.

Entrainment of Air

An average hemlock pulp fiber is about ⅛ in. long, and if it were round in cross section would be approximately 1/1000 in. in dia. It has a unit tensile strength equal to some grades of steel and for its size has a remarkable stiffness to resist bending. The tubular fiber structure when suspended in water is easily tangled with other fibers or matted into a sheet. It has a marked tendency to flocculate or combine with other fibers into bundles which act as units in flow. These "flocks" as they are called form in all pulp at high consistencies; and in some cases they occur in consistencies as low



Schematic diagram of water flow in a typical paper mill

as ½ per cent. The size of the flocks and their tendency to form depends upon consistency, length and stiffness of the fiber, and the nature of flow to which the pulp is subjected.

At points in a system of flow where consistency is being changed by adding or removing water, flocks absorb or give up water. When dilution becomes extreme, the bundles are dispersed and the fibers lose contact with each other. At this point the fluid assumes the free-flowing character of water. All pulp of consistencies which will support flocculation is subject to entrainment of air. In other words, air may be held by any pulp suspension that is dense enough for the entanglement of fibers.

Entrainment of air is a serious problem wherever a centrifugal pump is involved. The vortex of the pump separates the air from the pulp and causes it to collect near the center of rotation. Pockets of air thus formed reduce flow and may interfere with production. In some applications special agitating devices are required to relieve the pulp of excessive air.

Troublesome air in pulp has been a subject of research by pump designers since the introduction of the centrifugal pump into this service. Only in the last few years has substantial progress been made in this field.

The Flow of Pulp

Delivery of paper pulp through pumps and pipe lines is the paper industry's means of handling material. Many of the pump manufacturers offer a full series of pumps designed exclusively around the problem of handling heavy pulp stock. The style of centrifugal pump generally used for this service is of the single-end-suction type with a large ported compound impeller having two or three open-type blades.

Some pump designers use an inlet connection two and even three pipe sizes larger than the discharge in order to get low velocities on the approach to the impeller. Others prefer a relatively small impeller eye to get low blade velocity at the point the pulp is picked up. The recent tendency has been toward the small inlet size which, in general, is one pipe size larger than the discharge connection.

Some pump manufacturers have advertised their equipment as capable of pumping stock up to 7 and 8 per cent consistency. This may have been done in cases where conditions were ideal, but in general a 4 to 5 per cent free stock is as high a consistency as can be handled with assurance. As the higher consistencies are inclined to carry greater quantities of air, the limiting factor may prove to be air instead of lack of fluidity.

Heavy pulp flowing through a pump or pipe line is greatly retarded by friction. Pipe-line calculations may be made by use of friction curves which are available from a number of different sources. Curves shown in the book of standards of the Hydraulic Institute cover both sulphite and groundwood pulp.

Pump Kinks

The sulphite curves show greater friction than groundwood. Sulphate or kraft pulp has greater friction than sulphite. Soda pulp falls between sulphite and groundwood. In general, all pulp friction curves refer to free stock of the kind of pulp for which they are drawn. Friction values may be modified if the stock has been beaten.

To illustrate relative values of pipe friction in pulp as compared to water, the curves from the book of standards show in a 6-in. iron pipe at 500 g.p.m. of water flow a friction loss of 3.3 ft. per 100 ft. of pipe, while 4 per cent sulphite pulp shows a loss of 54 ft. under similar conditions of operation.

The location of all pumps for handling pulp stock should be such that the supply will have as much gravity head as possible for feeding into the pump. A suction lift into a pulp pump is sure to be a source of trouble.

A multiple discharge in a line leading from a pump is to be avoided. It is almost impossible to make pulp flow from one pump to two different points of destination at the same time. When this is tried, slight variations in consistency will cause the head in one of the branch lines to rise above that of the other branch line with the result that all of the flow of pulp will be discharged through the branch having the lower head. When this occurs, water will drain from the pulp in the line that has no flow, forming a plug of hard matted fiber. A plug of pulp thus formed may become so hard and tight that it is necessary to disassemble the pipe for removal.

Instrumentation of flow in any pipe line where pulp fiber is encountered is extremely difficult owing to the tendency of the fiber to plug up the small pipe openings by which pressure measurements are taken. Owing to the practice of the industry to operate at a known tonnage or rate of pulp flow through parts of the mill, a close approximation of the quantity of liquid flow may be calculated from consistency tests made at or near the point where the check is to be made.

This is done by use of the formula: Flow in gallons per minute equal Mill production (t. per da.) times 167 divided by (Consistency in per cent).

A study of the mill flow diagram will reveal how universally the method may be used.

As an example in using this method of checking the rates of flow at a point where water is being added to the flow of pulp, consistency samples may be taken from the stream before and after the dilution. The difference between the calculated flow values at these points would give the approximate quantity of dilution water used.

ICE PREVENTION

To PREVENT ice from collecting against the Grand Coulee Dam in the winter, the Bureau of Reclamation is installing an ice-prevention system that will provide a curtain of air bubbles through the water against the upstream face. A thousand small nozzles, attached to pipelines situated below the surface of the large reservoir and fed by four compressors, will each blow from 2 to 3 c.f.m. of air into the water to keep it constantly agitated.

This will prevent ice from forming near the trashracks, protecting the entrances to the tubes which carry water to the turbine-generators in the powerhouses and to pumps of the future irrigation pumping station. Ice formations, if allowed to remain, could damage the concrete columns and upstream face and interfere with the gates.

A 4-in. supply line has been laid in one of the galleries or tunnelways inside the dam, to carry the air to branches of 1-in. copper tubing embedded in the concrete, and through these to the pipes along the upstream face. The capacity of the system is rated at 380 c.f.m. The nozzles, equipped with ⅛-in. openings, have been installed at several levels, varying from 8 to 51 ft. below the water line.

The PRACTICAL ENGINEER *and* ELECTRICIAN

RICHARD H. MORRIS, EDITOR

The Practical Man Is Tops Again. Are You Doing Your Part?

WITH BILLIONS of dollars flying around like leaves in an autumn wind, conversion from peace to war production has the sound of Big Business. While it is true that Big Business carried the brunt of the first shock because it had the organization and facilities, Donald Nelson has made it clear that the Battle of Production will be won or lost by Little Business. Divided into some 184,000 units many devoted to some special product with but limited facilities, L.B. is at a tremendous disadvantage.

No power on earth, save individual initiative, will marshall these thousands of heterogeneous units into well coordinated unit. Each must find it's own niche in the war machine by itself just as it did in the peacetime machine, but, with two important limitations the job must be done immediately and done with the equipment now on hand.

Thus the task of the production engineer is set. But what of the thousands of other engineers who back him up with light, power, heat and other services and the other thousands who do the same for essential civilian needs? Their job is just as difficult and also clear cut,—to do more than ever before, do it better and do it with what's on hand!

Not many decades ago an engineer had to be a practical jack-of-all-trades, solve his own problems by his wits and make a good deal of his own equipment. True, much of it was makeshift but it answered the purpose. Today's engineer must prove himself as self-reliant as his father or grandfather.

And they are! Already we are receiving a number of articles dealing with these emergency makeshift schemes but not nearly as many as we should. At this time every engineer should consider it his patriotic duty to pass on to other engineers his experience with practical, short cut, and emergency methods.

They may sound—and probadly are—simple things that any good engiener would think of himself. But remember that everyone is extremely busy these days and there is not sufficient time for extended thought and planning for everything. So-you send in what you have done in one direction, another engineer sends in what he has done in another direction, etc., and pretty soon we have a fund of worth while, practical ideas covering every part of the field. Many of these will be applicable directly in other plants others will be valuable only in that they give another engineer a clew as to how his own problem can be tackled.

Jump on the bandwagon and do your part—if your idea seems too simple to bother with, well, send it in anyway and pass the buck to the editor—he's paid for deciding things like that!

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The Easy Way to Select

ECONOMICAL CHIMNEY SIZES

The author's contention is that arbitrarily selected and sized chimneys result in more smoke nuisance than all other causes combined. After developing the theory behind chimney design he presents a new table which is easier to use than previous tables. It is arranged in the same form as Kent's well known table but designed to take into account factors which Kent considered as constants, or, neglected[1]

By J. G. MINGLE

TO ALL intents and purposes, a natural-draft chimney may be considered as an air pump similar to an induced draft fan[2]. It has operating characteristics which are similar in all respects to those of centrifugal fans and blowers, and centrifugal pumps. Centrifugal fans and blowers, and centrifugal pumps, are classified into a general group of plant auxiliaries which may be termed as pressure transformers and among which should be included natural-draft chimneys. Each type of pressure transformer is subject to a performance interpretation by means of performance characteristics which are the plotted results on cross-section paper of a laboratory test made under arbitrarily imposed operating conditions.

These laboratory tests parallel closely the actual operating conditions to which the fan or pump will be subjected in the plant in which it will ultimately be installed. Each type of pressure transformer, including the chimney, has: a head-capacity curve which expresses the relationship between the head, or draft, created and the capacity delivered; a horsepower curve which indicates the amount of energy involved in effecting the head-capacity relationship; and an efficiency curve which expresses the relationship between the energy output and the energy input.

Variables Cannot Be Neglected

In the selection of the required size of a centrifugal fan for a definite set of operating conditions, it is necessary to know the temperature of the gases to be handled, the mean atmospheric temperatures, the unit weight of the gases, the elevation of the plant above sea level, and in addition the amount of gases to be delivered and, what is of equal importance, the total dynamic draft against which the fan is to operate. Likewise, in the selection of a centrifugal pump, it is necessary to know the amount of water to be delivered and the total dynamic head against which the pump is to operate.

Since the operating characteristics of a natural-draft chimney are similar to those of centrifugal fans and pumps, the selection of the required size of a chimney involves not only a definite knowledge of the chimney-gas temperature, the mean atmospheric temperature, the unit weight of the gases, the elevation of the plant above sea level, the friction coefficient and the amount of gases to be delivered, but also the total dynamic draft against which the chimney is to operate.

No Gas Core

Gases within a chimney are non-compressible and there is no such condition as a core of gases flowing through a so-called ring of non-flowing gases adjacent to the chimney walls. The velocity of the gases next to the chimney walls is of course slightly less than that in mid-stream but there is considerable of a velocity of the gases adjacent to the walls and it is absurd to consider this velocity as being equal to zero.

Velocity of the chimney gases is the mean velocity throughout the section. Gases passed on to the chimney by the furnace must get out of the chimney with a certain mean velocity in feet per second and are not squeezed into a smaller stream, or core, to produce a higher velocity. This so-called 2-in. non-effective area does not exist in circular ducts conveying non-compressible gases at a relatively low velocity. In other words, there is no diminution of the area of the chimney. The gases have a definite mean velocity while flowing through the entire area of the chimney.

The required diameter of a chimney is given by the general equation,

$$D = K_d \sqrt{W/V}$$

and the required height by the general equation,

$$H = D_r \div [d_t - K_h (V^2 \div D)]$$

where

D = required diam. of chimney, ft.

H = required height of chimney, ft.

W = maximum amount of gases generated by the furnace and passed on to the chimney, lb. per sec.

d_t = theoretical draft per ft. of chimney, in. of water

V = velocity of chimney gases, ft. per sec.

D_r = total dynamic draft, in. of water

K_d and K_h = constants which take into account the temperature and density of the chimney gases, the temperature and density of the atmosphere, the barometric pressure corresponding to elevation and the friction coefficient.

It will be seen that there will be as many sizes of chimney as there are values of velocity to be assumed.

As a typical example, let it be assumed that the total dynamic draft requirement is 1.17 in. of water, the maximum amount of gases generated and passed on to the chimney to be delivered is 116 lb. per sec., and that the chimney-gas temperature is 600 deg. F., the mean atmospheric temperature 62 deg. F., the chimney-gas unit weight 0.08 lb. per cu. ft., the friction coefficient 0.018 for sooted surfaces and that the plant is at sea level.

Table I gives the required diameter and its corresponding height for various assumed velocities. The required sizes vary between a diameter of 27.38 ft. and a height of 167 ft. for a chimney-gas velocity of 5 ft. per sec. and a diameter of 7.31 ft. and a height of 867 ft. for a chimney-gas velocity of 70 ft. per sec.

Of this assortment of sizes, the question arises as to which one to select. All other factors being equal, the most natural selection is the one whose cost will be least. On this assumption, the factors HD (product of diameter and height) is the cost criterion. Hence, the size whose cost will be least will be that whose HD factors will be least.

Table I. Chimney sizes for various chimney gas velocities

Velocity of chimney-gases, ft. per sec.	Required diameter, ft.	Required height, ft.	Product of diam. and ht. ft.
5	27.38	167	6550
10	19.35	168	3250
15	15.83	169	2680
20	13.67	173	2360
25	12.25	177	2170
30	11.18	184	2060
35	10.33	194	2010
37.5	10.00	200	2000
40	9.67	208	2010
45	9.13	227	2070
50	8.66	256	2210
55	8.25	298	2460
60	7.90	369	2920
65	7.58	509	3860
70	7.31	867	6340

[1]The author's reasons for feeling that Kent's Table of Chimney Sizes for Commercial Horsepower are outmoded for present day practice are fully developed in a letter appearing on page 94 of the June, 1941 issue of POWER PLANT ENGINEERING. The table in this article is the new one promised by the author in his June letter as a replacement of Kent's table and in a form easier to use than the one on page 66 of the December, 1940 issue under the title "Relation of Chimneys to Smoke Abatement."

[2]This idea was developed fully by Mr. Mingle in an article which appeared on p. 245 of the April, 1939 issue of POWER PLANT ENGINEERING.

Table II. Mingle's Table of Economic Chimney Sizes based on: a chimney-gas temperature of 600 deg. F.; a mean atmospheric temperature of 62 deg. F.; a chimney-gas unit weight of 0.08 lb. per cu. ft.; a mean friction coefficient of 0.018 for sooted surfaces; and, sea level elevation.

Diam. of chimney, ft. and in.	Height of Chimney, ft.									
	75	100	125	150	175	200	225	250	275	300
	Upper figures—capacity, lbs. of gases per sec. Lower figures—available draft, in. of water.									
3'0"	6 0.44	6 0.59	6 0.74							
3'6"	8 0.44	8 0.59	8 0.74	8 0.88						
4'0"	12 0.44	12 0.59	12 0.74	12 0.88	12 1.03					
4'6"	16 0.44	16 0.59	16 0.74	16 0.88	16 1.03					
5'0"		21 0.59	21 0.74	21 0.88	21 1.03	21 1.18				
5'6"		26 0.59	26 0.74	26 0.88	26 1.03	26 1.18	26 1.32	26 1.47		
6'0"		33 0.59	33 0.74	33 0.88	33 1.03	33 1.18	33 1.32	33 1.47		
6'6"			39 0.74	39 0.88	39 1.03	39 1.18	39 1.32	39 1.47		
7'0"			49 0.74	49 0.88	49 1.03	49 1.18	49 1.32	49 1.47	49 1.62	49 1.76
7'6"			58 0.74	58 0.88	58 1.03	58 1.18	58 1.32	58 1.47	58 1.62	58 1.76
8'0"			68 0.74	68 0.88	68 1.03	68 1.18	68 1.32	68 1.47	68 1.62	68 1.76
8'6"				79 0.88	79 1.03	79 1.18	79 1.32	79 1.47	79 1.62	79 1.76
9'0"					91 1.03	91 1.18	91 1.32	91 1.47	91 1.62	91 1.76
9'6"					104 1.03	104 1.18	104 1.32	104 1.47	104 1.62	104 1.76
10'0"					119 1.03	119 1.18	119 1.32	119 1.47	119 1.62	119 1.76
10'6"					134 1.03	134 1.18	134 1.32	134 1.47	134 1.62	134 1.76
11'0"					151 1.03	151 1.18	151 1.32	151 1.47	151 1.62	151 1.76
11'6"					169 1.03	169 1.18	169 1.32	169 1.47	169 1.62	169 1.76
12'0"					187 1.03	187 1.18	187 1.32	187 1.47	187 1.62	187 1.76
12'6"					207 1.03	207 1.18	207 1.32	207 1.47	207 1.62	207 1.76
13'0"					228 1.03	228 1.18	228 1.32	228 1.47	228 1.62	228 1.76
13'6"					252 1.03	252 1.18	252 1.32	252 1.47	252 1.62	252 1.76
14'0"					275 1.03	275 1.18	275 1.32	275 1.47	275 1.62	275 1.76
14'6"					301 1.03	301 1.18	301 1.32	301 1.47	301 1.62	301 1.76
15'0"					328 1.03	328 1.18	328 1.32	328 1.47	328 1.62	328 1.76
15'6"					355 1.03	355 1.18	355 1.32	355 1.47	355 1.62	355 1.76
16'0"					384 1.03	384 1.18	384 1.32	384 1.47	384 1.62	384 1.76
16'6"					415 1.03	415 1.18	415 1.32	415 1.47	415 1.62	415 1.76
17'0"					446 1.03	446 1.18	446 1.32	446 1.47	446 1.62	446 1.76
17'6"					480 1.03	480 1.18	480 1.32	480 1.47	480 1.62	480 1.76
18'0"					516 1.03	516 1.18	516 1.32	516 1.47	516 1.62	516 1.76
18'6"					553 1.03	553 1.18	553 1.32	553 1.47	553 1.62	553 1.76
19'0"					590 1.03	590 1.18	590 1.32	590 1.47	590 1.62	590 1.76
19'6"					630 1.03	630 1.18	630 1.32	630 1.47	630 1.62	630 1.76
20'0"					670 1.03	670 1.18	670 1.32	670 1.47	670 1.62	670 1.76

Therefore, that velocity which will result in a chimney size whose HD factors will be the least is the economical velocity whose value will determine the economical chimney size. The cost of the chimney size determined by the economical velocity will be less than that of any other size as determined by any other velocity.

The equation for the economical velocity is developed by deriving an equation for HD in terms of V, differentiating this equation with respect to V, equating the resulting expression to zero and finally solving for V_e, the economical velocity. This equation may be represented in its simplest form by the expression,

$$V_e = K_v W^{1/5}$$

where V_e = economical chimney-gas velocity, ft. per sec.

W = maximum amount of gases to be delivered by the chimney

and K_v = a constant which takes into account the chimney-gas temperature and density, the atmospheric temperature and density, the friction coefficient and the barometric pressure corresponding to altitude. (In the example, $K_v = 14.4$.)

Substituting the simplified equation for V_e in the simplified equation for the required diameter, then the equation for the economical diameter D_e in ft. is equal to,

$$D_e = 1.5\ W^{2/5}$$

Also substituting the simplified equation for V_e in the simplified equation for the required height, and since the theoretical draft per foot of chimney $d_t = 0.00703$ in. of water, then the equation for the economical height H_e in ft. is equal to,

$$H_e = 170\ D_r$$

Whence, for a value of 116 lb. per sec. for W,

$$D_e = 1.5\ (116)^{2/5} = 10 \text{ ft.}$$

and for a value of 1.17 in. of water for D_r,

$$H_e = 170 \times 1.17 = 200 \text{ ft.}$$

Hence, the economical size for the operating conditions noted in the typical example is 10 ft. in diameter and 200 ft. in height.

The table of chimney sizes accompanying the article[1] in the Dec., 1940, issue of POWER PLANT ENGINEERING was constructed in accordance with the theory outlined above. This method of determining the required size of a chimney includes all of the factors which might affect the size in one way or another and has the added advantage of giving the most economical structure from the standpoint of cost. The method is definite and complete, nothing being left to guess-work or the judgment of the one making the selection.

This economical velocity, besides producing an economical chimney structure from the standpoint of cost, also effects a compromise between an excessively high capacity under reduced draft conditions and an excessively high available draft intensity under reduced capacity conditions. In other words, the economical velocity gives the chimney a "steep" draft-capacity characteristic.

It is possible to select a specific and proper size of chimney for any set of operating conditions as easily and methodically as is possible to select a specific and proper size fan for a similar set of operating conditions, but not by the use of Kent's table. Fan manufacturers would never dream of attempting to select a proper size fan for a plant without definite information of the total dynamic draft requirements, as well as the other operating conditions.

It would not even be possible to select a fan without knowing the draft requirements against which it is to operate. But it has been the custom to make a guess-work selection of chimney sizes from Kent's table without a knowledge of even the approximate draft intensity against which it is to operate.

A table of chimney sizes on the order of Kent's table for chimney sizes may be constructed by solving for W and D_r in the two simplified equations for these factors as follows:

$$W = 0.375\ D^{5/2}$$

$$D_r = 0.00588\ H$$

Table II gives the chimney size for various amounts of gases to be delivered and required draft intensities, based on a mean atmospheric temperature of 62 deg. F., a chimney-gas temperature of 600 deg. F., a chimney-gas unit weight of 0.08 lb. per cu. ft., a mean friction coefficient of 0.018 for sooted surfaces and sea level elevation.

CONSTRUCTION AND REPAIR

Los Angeles Moves a Steel Tower

By CLAYTON M. ALLEN
Assistant Mechanical Engineer
Design and Construction Division
Los Angeles Bureau of Power & Light

MOVING and raising transmission line towers has become routine work with the Construction Division forces of the Los Angeles Bureau of Power and Light. Due to the many unusual conditions surrounding the 22 ft. move of a 110,000 v., double-circuit, 30 t., right angle tower carrying two circuits of 500,000 c.m. copper cable and one ½ in. steel ground wire, further mention may be of interest to utility engineers.

The original reinforced concrete footings for this tower were constructed in 1926 and consist of a reinforced concrete box set on four 36-in. diam. reinforced concrete 84-ft. columns which were constructed in wells drilled with the customary well rig. A small section of the Los Angeles river channel at this point carried the run-off water during previous flood periods. The full dedicated width of the channel was never used and 25 towers of this line were located 15 ft. in the channel, which at the time of construction was on top of the bank and out of the natural river course.

The U. S. Army engineers are constructing flood control works in this river channel, placing reinforced concrete side walls and concrete bottoms for the full length of the dedicated river bed. The portion of the river bed between the Union Pacific Railroad Crossing and Washington Boulevard Bridge was constructed with straight sides instead of sloping sides, and left about three-fourths of one of the Bureau's towers projecting in the completed river channel.

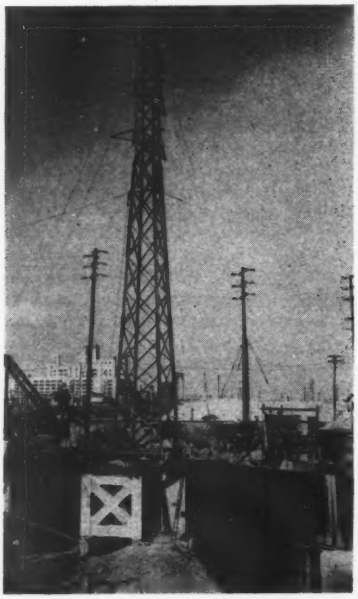


Fig. 1. The 132 ft. 90 deg. tower about one third of the way from the old footing, in the relocated river channel, to the new footing behind the retaining wall. Circuits cut at midnight Saturday were back in service at 1:30 A. M. Monday

The tower was moved at the request of the U. S. Engineers, and although one of the reinforced concrete columns was used, it was necessary to drill three new wells for columns, reconstruct a new concrete box-like structure, and move the tower over on this new foundation. Temporary guy cables were installed on the basket of the tower anchoring same across and down the river to relieve the strain from the East leg of the tower so that the concrete box around that leg could be cut away and the new box foundation constructed using this old column and the three new ones.

With a new foundation consisting of one old stub and three new stubs concreted in place, reinforcing I-beams were installed on the tower near its base in order to hold the structure rigid during moving operations. Four 24 by 7 in. I-beams were installed on the foundations for moving tracks. Four 14 by 5 in. I-beam shoes 18 in. long were attached to the tower legs and the supporting structure. With all moving track beams rigidly cross-braced, the lower tower members were removed and replaced with temporary bracing to facilitate moving operations.

A clearance was taken out on the line at midnight, Saturday, October 26, and the conductors were disconnected one by one and the back guys were released in a predetermined sequence until all were removed, and all but the necessary moving guys remaining. The splice connections between the tower legs and the stubs were then removed.

By using hydraulic jacks, the 30 t. tower was raised so that 1¼ in. steel rollers 8 in. long between flanged ends could be placed between the four moving shoes and the four I-beam tracks. At 1:30 P.M. Sunday the signal was given to start moving. The hoistmen operating the double-drum, gasoline-driven hoist started pulling the tower over to its new position while the back and side guys were being released.

Fig. 2. The new foundation was made solid and slightly lighter because it is back of the flood control wall and out of the channel. Openings in the new foundation are for anchor rods for the steel sheet piling which will be installed when the old foundation is demolished. As the tower was moved the diagonal stay-bracing on the middle rail beam for the East leg was removed and installed to the rear of the tower leg. Note the stubs in place ready for the legs to be bolted on

Actual moving operation consumed about 1½ hr. As soon as approximately 50 per cent of the bolts in tower leg to stub connections were replaced and all diagonal braces replaced, the line crews started replacing the conductors and the ground wire, in a sequence predetermined by conference between design and construction forces prior to start of operations. This was after they had been shortened on one side and length-

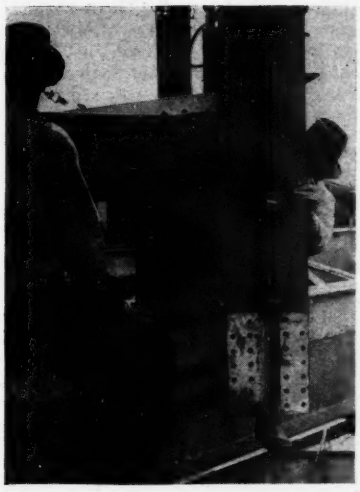


Fig. 3. Close up of the moving shoes showing the 1½ in. steel rollers with flanged ends

ened on the other side of the tower to take care of proper tension with the tower in its new location in accordance with calculations of the design engineers.

Lines were restored to service at 1:30 A.M. Monday, allowing the Bureau's Loop Transmission about the City to function normally again, and the U. S. Army Engineers to close the gap in their flood protection wall, removing the obstructions to the smooth flow of the waters of the Los Angeles River at flood periods.

All operations were carried out under direct supervision of James F. Moran, general construction superintendent, and Charles W. Ragan, construction superintendent, assisted by James A. Joyce, chief transmission line patrolman, and under direction of R. R. Robertson, engineer of design and construction, and G. E. Benkesser, superintendent of construction.

Redeemables

By Atomizer John

TAKE a deep breath and hold it while lighting a burner; in case of a flash back no hot gases or flames will be drawn into the nose or lungs.

Respirators should be worn while cleaning tubes. The abrasive dust quickly irritates the membranes of the air passages. This may later result in sinus infection, colds or even lung trouble.

Safety goggles are strong enough to stop a piece of flying metal which if it struck the eyelid would go completely through it and the eye. They also keep out particles of dust which cause eye irritation, which may result in painful sties, dry eyes or infected tear glands.

When working around an electric welder the wearing of light tinted safety goggles which cut out the ultra-violet rays will eliminate many headaches and, more serious, eye burns.

A scratch, not first-aided, is a gilted door inviting the entry of infectious germs.

When working above other men with tools, a short piece of sash cord tied to the handle of the tools and the other end tied to some fixed point may make the tools more awkward but it will raise the life-expectancy of the men working below.

If heavy oil which is hotter than 212 deg. F. is splashed upon a workman, do not attempt to peel the oil off. The surface under the oil is sterile, the only one qualified to remove the oil is a doctor.

Never slap lubricating oil, lard, butter or any greasy substance on a serious burn, for most doctors today use a burn treatment which is not effective if oil or grease is present, hence the application of any of the oily substances will delay effective treatment until it has all been removed.

The average 110 v. extension cord should not be used for tubes, drum or any other inspection where moisture is encountered. A 6 v. extension or flash light is much safer.

A pair of tongs, made like ice tongs, with one or two hand grips make the handling of hot oil or gas burners much safer and easier.

A bucket of clean water or an open shower spray may save an operator from serious chemical burns, especially in the eyes, when handling water treatment or testing chemicals.

Fuller's earth or dry cement sprinkled on oil spots makes them almost skid-proof and easy to clean up.

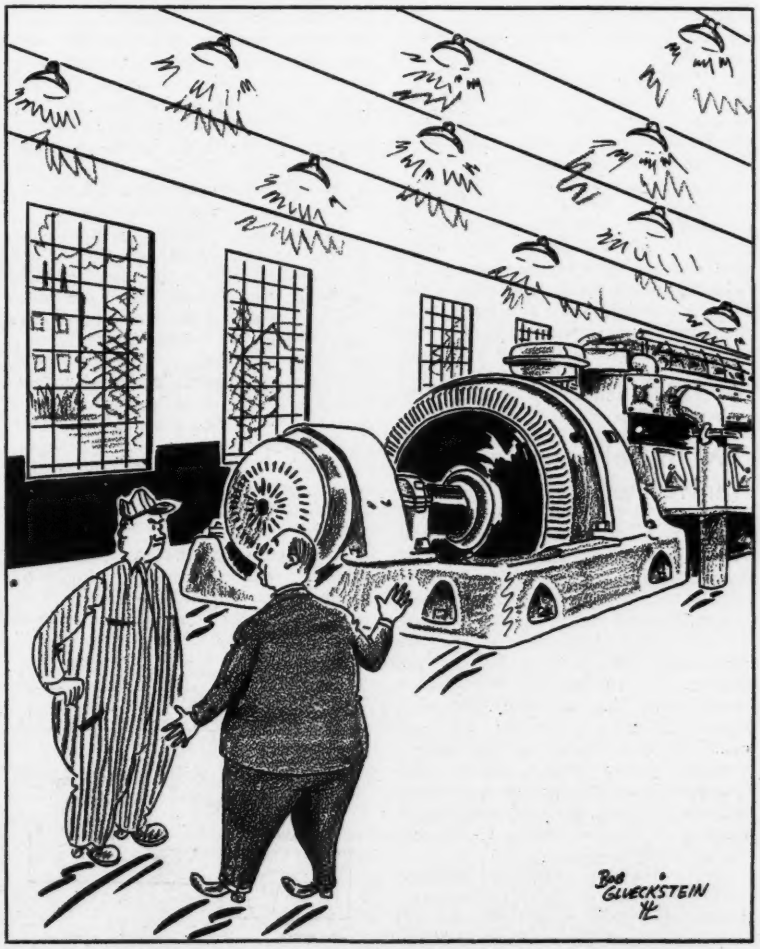
All men working around fuel burning equipment should be taught to identify heat exhaustion and trained to treat a patient suffering from it.

A pound of vaporized gasoline when ignited in a closed space releases the force equivalent to 86 lb. of 40 per cent dynamite. Gasoline should never be used to clean floors, machinery or clothes.

Stationary engineers have a very reasonable insurance rating, the only way this can be continued is by establishing a definite set of safety rules in each individual plant and intelligently following them. In case of an emergency the best protection of life and equipment is to have the men trained in advance what their individual duties are. When nothing is left to chance or luck — that's safety.

* * *

In an eastern plant a bad case of corrosion in the base of a steel chimney was successfully handled by filling the base of the stack with concrete.



Must you have all these lights? How about helping us cut down on the overhead?

FOR THE PLANT ELECTRICIAN

An Armature Testing Kink

By P. C. Ziemke

SOME YEARS ago I had a novel experience when a 4 t. electric locomotive developed a bad armature and it was considered expedient to replace it before a bad burnout occurred.

When the factory wound spare was in place and the locomotive was started the machine leaping up and down in regular rythm as it rolled forward. Reversing the unit made no change, the bucking bronco style still persisted. Then followed several hours of intensive searching for the elusive trouble but with no results the bronco still bucked. Finally another machine was pressed into service from a less busy section and the balky armature was taken up to the shop for a thorough check up.

There the unit tested favorably when every known type and kind of equipment was used on it. That evening a grizzled old street car repair man was consulted and a new trick was learned. Early the next morning we used a hunting compass to explore each armature coil as it passed under the needle with a light current applied. As the separate coils moved on the needle swung forward and back in even stride until suddenly the needle reversed its swing and the trouble was bared, nothing more serious than a reversed coil but a real trouble maker nevertheless. That explained why the machine bobbed up and down as the polarity and flux reversed under the brushes with each revolution of the armature.

How to Determine a Transformer Ratio

By S. H. Coleman

TRANSFORMER ratio is the numerical relation existing between the no-load primary and secondary voltages. It occasionally becomes necessary to determine this ratio in the field, especially where the name plates ordinarily bearing this information have become lost or are illegible. In the case of large power transformers the comparatively small number of turns making up the coils makes the determination of this value a relatively simple matter. Small high voltage transformers present an entirely different problem, however, and require much more careful testing if accurate results are to be obtained.

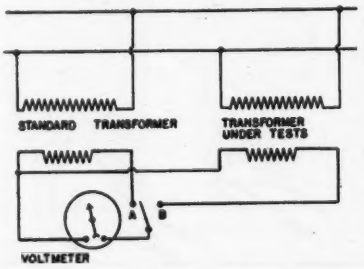
There are two commonly accepted testing procedures used to ascertain transformer ratios, namely the standard transformer, and, the voltmeter methods. When making a ratio determination using either of these means it is well to remember that the transformer should be energized with a current having a frequency as high or higher, and an impressed voltage either equivalent to or lower, than the values for which the unit was designed.

Should the frequency be abnormally low or the voltage be too high, exciting current and core density will be unduly large. In making the ratio test it is usually possible to use a voltage as low as 10 per cent of the rated voltage, except in the case of small transformers of 0.5 kw. rating or less and having an exciting current of more than 10 per cent. This is due to the fact that at low core densities the exciting current does not diminish as fast as the voltage, thus giving a small ratio error due to the leakage impedance drop brought about by the exciting current.

Power transformer ratios are usually determined by the voltmeter method. In making this test two voltmeters are required, one to indicate the potential of the high voltage winding and the other that of the low voltage winding. Should potential transformers be needed in conjunction with the voltmeters, their ratios must be identical, or the meter errors will not compensate and a correction factor will have to be applied.

When making the test, simultaneous readings of the impressed voltage and the voltage induced in the other winding, should be taken. Following these readings, and with the same voltage on the same winding as before, the voltmeters should be interchanged. This test should be repeated at several impressed voltage values, differing, it is suggested, by 10 per cent. The ratios obtained from these readings should check within 1 per cent. If errors greater than 1 per cent are apparent, meters should be recalibrated or a different set of accurate instruments obtained.

Ratio measurements on transformers provided with tap changers should be taken on both the full winding, and on each of the other positions. Two sets of readings should be taken on each position interchanging the voltmeters in the manner previously described. The same procedure should be followed in testing transformers not provided with tap changers, but having taps brought out to a terminal board.



Connections for determining a transformer ratio by using a standard test transformer

Checking ratios by means of the standard transformer method has a number of advantages, so far as distribution transformers are concerned. If the voltmeter method of ratio determination is applied to such transformers it is necessary to use voltages that are very nearly normal in order to secure accurate results. This means that voltages of dangerous magnitude must be applied. Any attempt to use potentials very much below normal is likely to set up an appreciable error due to the drop caused by the load of the measuring instrument.

In making a comparison by the standard transformer method, a test transformer of known ratio and having a number of taps covering a wide range in relatively small steps is most generally employed. Necessary connections are shown in the wiring diagrams. Primaries of both transformers are connected in parallel. Secondaries are backed up so that by first closing switch A, and then flipping it over to B, secondary voltages of the two transformers are obtained.

With the switch at A, the voltmeter reading multiplied by the ratio of the standard transformer will give the impressed voltage across the transformer under test. From this known value and the voltmeter reading with the switch B, the ratio of the transformer can be easily calculated.

Stops Slipring Pitting on Synchronous Motors

By Myron Carl

ONE OF THE vexing problems that confront maintenance men at large plants where large synchronous motors of the older type are used is the tendency of the direct current to cause pitting of the slipring through electrolytic action at the point of contact with the brushes. This condition is exaggerated if the cast iron ring is not of the best quality for at best it is but a poor conductor of electricity. Again the number of brushes provided may be inadequate for the amperage or the brushes may be poorly chosen for the type of service.

At one plant, a large mine where three 600-hp. synchronous motors were in constant service driving 2000 c.f.m. air compressors, early attempts to alleviate the trouble consisted of "stoning down" the rings at periodic intervals followed by careful adjustment of the tension on the brush springs. Later, several new types of brush compositions were tried with only mediocre success. The addition of an auxiliary brush on each brush assembly helped considerably but the real solution was not discovered since at least one ring on each unit continued to show abnormal wear.

This was traceable to the polarity of the circuit, thus, the final solution was achieved by installing a 100 amp., double pole, double throw, case enclosed switch in each motor pit. This

switch was, and still is, changed from contact with the upper or lower clips, as the case may be, on the first of every month and a predated page in the station log book serves as a reminder to the operator to perform this and various other tasks falling due that day.

Thus by changing the polarity monthly and equalizing the wear on both rings as compared to the old arrangement, plus the other means previously mentioned, the slipring trouble was corrected.

Laundry Engineer Retreads Carbon Brushes

By J. F. Fisher

BY USING a good grade of metal cement or mender I find that two pieces of carbon brushes can be welded together strong enough to use again. I am using these mended brushes on 220-v. d.c. reversing motors on cascade washers. They require little, if any, more attention than a new brush and result in a saving of ⅓ on brush expense.

My method is to square ends of the brush with file, apply a coat of metal cement and use a C clamp to compress the pieces firmly together. After standing for about 10 hr. they are ready to use. Have also used the doweling method successfully by drilling two holes about ¼ in. deep in each carbon, using a copper wire about ½ in. long for dowels, then applying the metal cement and compressing the pieces together. I have used one set of these mended brushes for the past 10 mo. and they are still in service. Don't throw away your short brushes, mend and use them.

HINTS AND KINKS

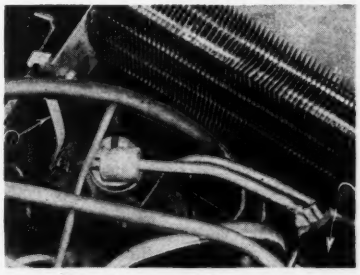
Why Not Build Your Own Cylinder Truck?

BY W. R. LINDEN
The Linde Air Products Co.
Newark, N. J.

ALTHOUGH cylinder trucks are available from manufacturers of welding and cutting equipment, many users of the oxy-acetylene process prefer to fabricate their own trucks. The sketch below shows construction details for a sturdy truck which can be fabricated economically from readily obtainable materials. If preferred, the cast iron wheels can be replaced with the "coaster-playwagon" type of wheel, or one of the many low-priced types of wheels available with pneumatic tires.

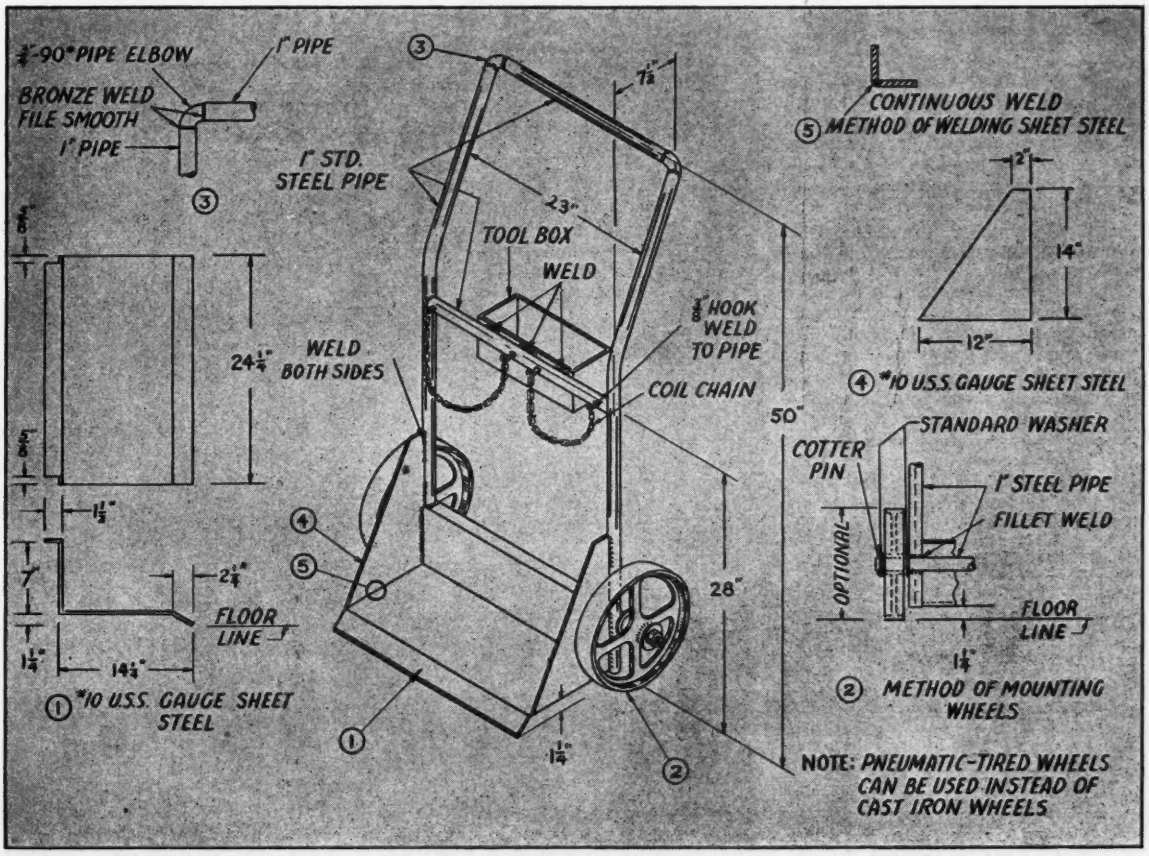
Blowing a Trouble Away

DRIP PANS under small air-cooling units are usually more than ample for all normal conditions. However, in a few localities the humidity is sometimes so high that water is squeezed out of the air faster than it can evaporate. The problem was to get rid of this water without the nuisance of a drain connection.



The simple expedient of attaching a metal strip to the drip pan has eliminated the water-collecting nuisance under small air-cooling units. Strips are indicated by arrows numbered 1 and 2

One day a Westinghouse engineer stood beside one of these machines in the laboratory. Puzzling over this problem, he chanced to touch the blade of a screwdriver to the water in the drip pan in front of the condenser fan. To his surprise water climbed up the blade,



Details of a sturdy truck for transporting cylinders. Numbers in circles on the truck refer to the small detail drawings at the sides

was blown off in a fine spray and evaporated. Here was the answer to the problem, for air blowing past the screwdriver standing at an acute angle created behind the blade a vacuum that drew the water upward to form a spray. Now, by fastening a flat curved strip of metal so that one end dips in the tray, excess water is blown into a spray as rapidly as it collects.

License Frames

BY B. H. WHITEHOUSE
Engineman in Charge
Milwaukee County House of Correction
Milwaukee, Wisconsin

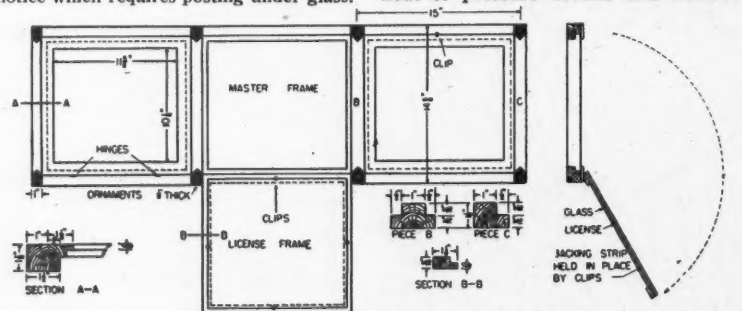
HAVE YOU ever visited different power plants just to see the machinery and equipment to be found there, and noticed the variety of engineers license frames in some of them? Some elaborate, some average and some just within the law that states that they must be on display under glass in the engine or boiler room. Undoubtedly you have, the same as I have and will agree with me that such a display does not improve the general appearance of the room very much. For this reason I developed the frame shown by the sketch and consisting of a master frame and the auxiliary frames.

This frame can be built to accommodate almost any number of men by extending in a horizontal position as shown and the whole thing can be mounted above an instrument board or hung on the wall. If a larger number is required it is best to make them two or more frames high and as long as necessary.

The auxiliary frames hinge out from the front of the master frame individually and a convenient arrangement of clips makes the removal and insertion of the licenses only the work of a moment.

The frame in the sketch shows only room for three licenses. The one actually in use in the Milwaukee County House of Correction power plant is built for five licenses and is mounted above the instrument board in the office. The dimensions are such that it accommodates a 10½ in. by 12 in. license. The stock from which it was made is shown in the small sketches.

Different mouldings can be used so that the frame will be as elaborate as desired. Paint or varnish will help adapt any color scheme or fancy. These frames are also useful for the posting of boiler inspection certificates, or any notice which requires posting under glass.



Details of a frame for engineers' licenses. This may be extended horizontally to include as many frames as necessary. The license is clipped inside the hinged cover

To Make a Pump Self Priming

By S. H. Coleman

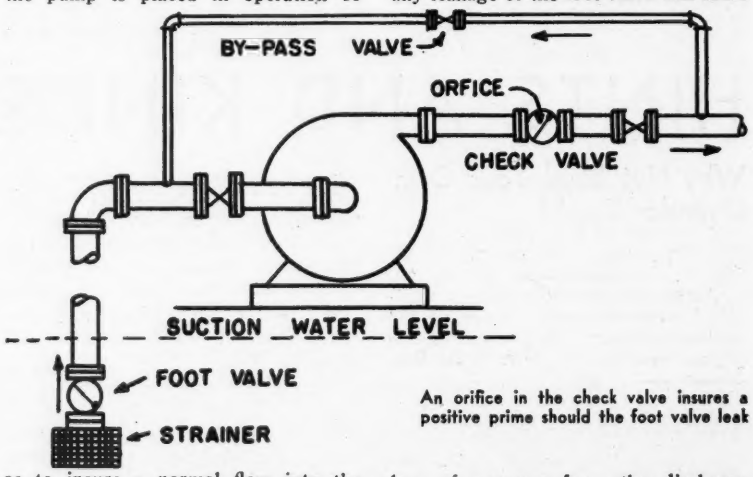
ENGINEERING of centrifugal pump installations with suction lifts requires careful consideration of numerous factors if expected performance is to be attained and operation is to be continuously satisfactory. Not only must suction piping be designed in accordance with the recommendations of the pump manufacturer, which are ordinarily based on modern hydraulic practice, but some means of priming the pump must be provided.

By priming is meant the filling of the suction system with liquid before the pump is placed in operation so as to insure a normal flow into the eye of the pump impeller. Unless this is done, the pump will not lift the water and may damage internal parts which depend upon the liquid for lubrication and sealing.

When pumps are run for a considerable period of time between shutdowns ordinary priming methods, namely the injection of liquid from a positive pressure auxiliary source into the suction piping or the use of some form of air removal device to create sufficient vacuum to effect the desired lift, are usually satisfactory.

With pumps which are operated at frequent intervals for short periods of time, however, some automatic system of priming should be resorted to. Such pumps are ordinarily controlled by float or pressure devices and without automatic priming it is obvious that a full time operator would have to be assigned to handle this particular job at each pump location.

It may be thought that if the suction piping is provided with a foot valve an initial priming when the pump is first placed in service would suffice since the valve would close each time the pump is shut down and hold the liquid in the suction system. Unfortunately foot valves are not always dependable and are subject to many factors which cause leakage, such as scale, dirt or other foreign material on the seating surfaces, wear, and occasionally sluggish operation. As it is almost impossible to prevent air from leaking into the pump casing, any leakage of the foot valve will cause loss of pressure from the discharge piping system when the unit is not running.



An orifice in the check valve insures a positive prime should the foot valve leak

Perhaps the simplest and most frequently used method of priming intermittently operated pumps that discharge into systems continuously under pressure, or, with a volumetric capacity sufficient for the purpose, is to drill a small hole in the discharge check valve. This hole or orifice should be large enough to pass sufficient liquid to maintain the prime, but, of course not so large that if the foot valve sticks in the open position, the back flow of liquid would tend to run the pump backwards when the power is shut off.

With this limitation to the quantity of priming water available through the orifice, provision should be made to take care of any condition requiring more water. A small valved bypass placed around the discharge check valve will take care of these emergency conditions.

* * *

Corrosion in condenser coils can in some cases be combatted successfully by painting with pure red lead after thoroughly cleaning the surface. Small pits should be cleaned very carefully and filled with red lead. Medium pits can be filled by an acetylene torch. Tubes with deep pits or large corroded areas should be replaced.

Correct Use vs. Common Faults with the Hand Torch

THE oxy-acetylene cutting torch consists of several small preheat orifices and a larger central oxygen or cutting nozzle. The preheat nozzles heat the metal almost to melting temperature. When the jet of pure oxygen is directed against it, the iron and oxygen react instantly forming iron oxide which is blown away. Actually the steel burns away and once started the torch can be moved along rapidly. The hand torch can be used to cut steel from light sheet to 10 or 12 in. thickness, straight, in curved or irregular lines or at a bevel. Properly handled the cut is regular with a narrow, smooth kerf as shown by these photographs taken by The Linde Air Products Co. While good cuts may be made by hand, machine guided torches are more accurate and have a greater thickness range.

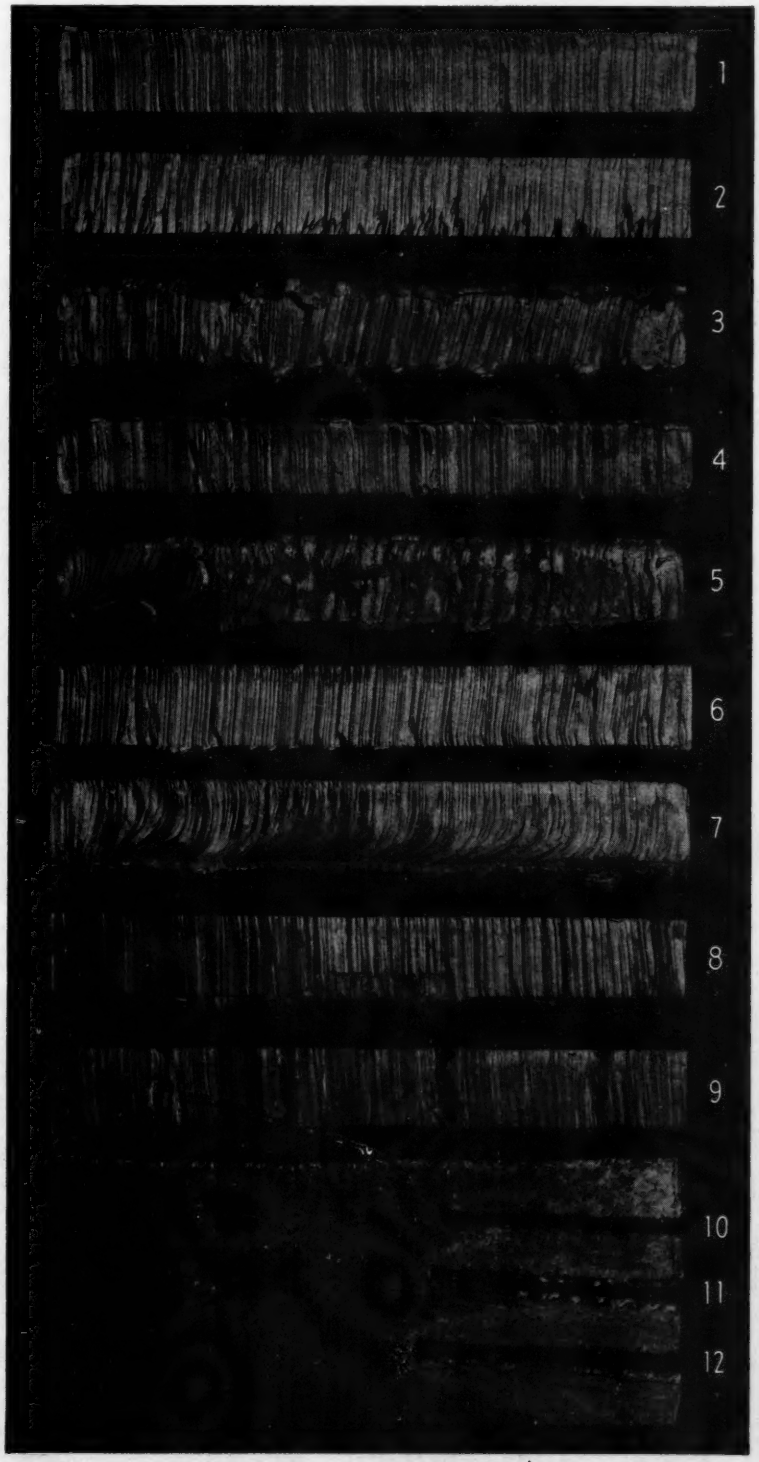


Fig. 1. Correct procedure. Compare this correctly made cut in 1-in. plate with those shown below. The edge is square and the drag lines are vertical and not too pronounced. (Reduced about ½ actual size.)

Fig. 2. Preheat flames too small or only about ⅛ in. long. Result: cutting speed was too slow, causing bad gouging effect at bottom

Fig. 3. Preheat flames too long or about ½ in. Result: top surface has melted over, the cut edge is irregular, and there is too much adhering slag

Fig. 4. Oxygen pressure too low. Result: top edge has melted over because of too slow a cutting speed

Fig. 5. Oxygen pressure too high, and nozzle size too small. Result: entire control of the cut has been lost

Fig. 6. Cutting speed too slow. Result: irregularities of drag lines are emphasized

Fig. 7. Cutting speed too high. Result: there is a pronounced rake to the drag lines and the cut edge is irregular

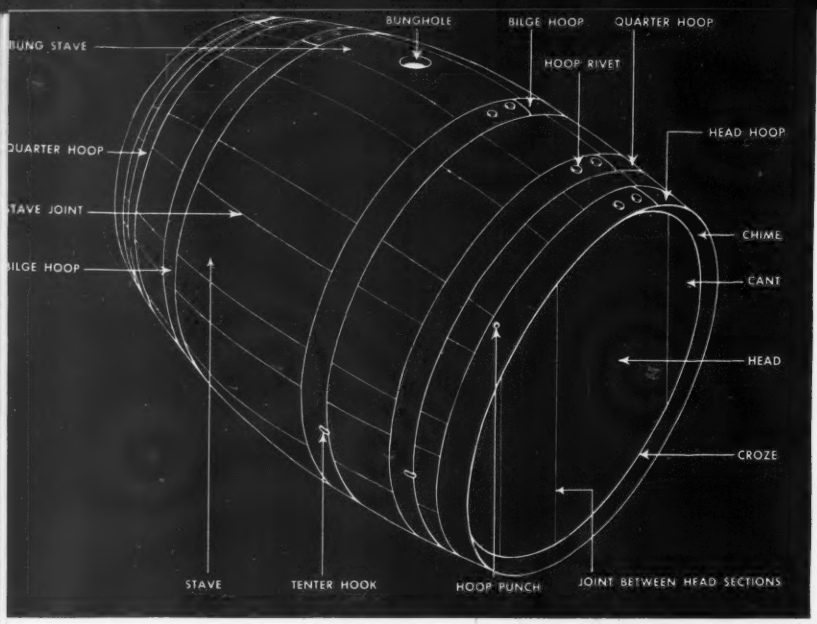
Fig. 8. Blowpipe travel unsteady. Result: the cut edge is wavy and irregular

Fig. 9. Lost cut not properly and carefully restarted. Result: bad gouges were caused where cut was restarted

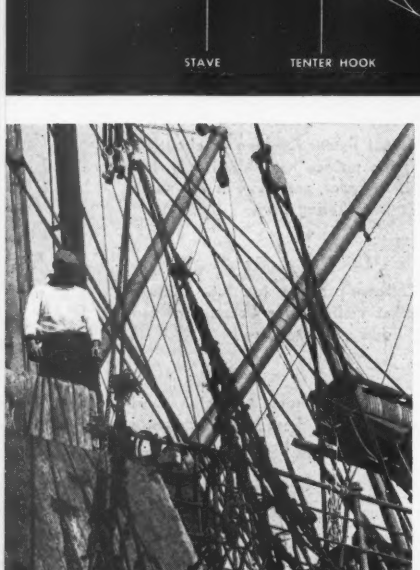
Fig. 10. Good kerf. Compare this view (from the top of the plate) of a good kerf with those below. This cut was made by using correct procedures

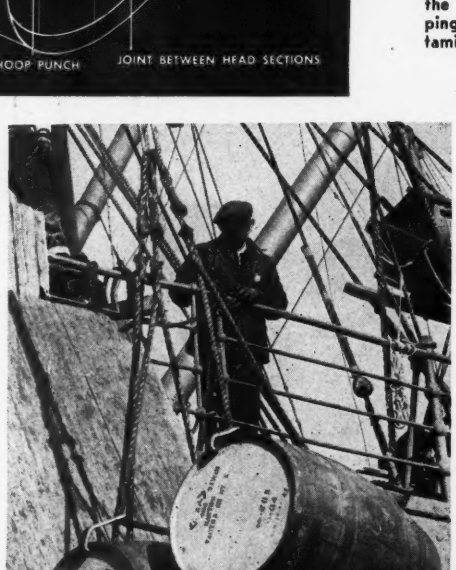
Fig. 11. Too much preheat and nozzle too close to plate. Result: bad melting over the top edge occurred

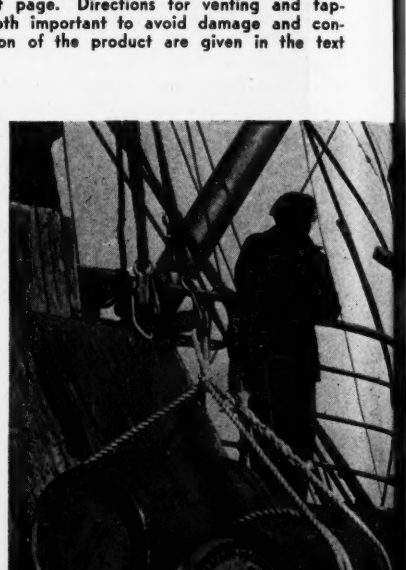
Fig. 12. Too little preheat and flames too far from plate. Result: heat spread has opened up kerf at top; kerf is too wide and is tapered



Two all but forgotten former standbys, the horse and the wooden barrel, have been brought back into service for the duration or until steel is again available for automobiles and steel drums. The wooden barrel, which is again, or will soon be, a regular feature of the power plant, will give good service if well made and properly handled. For oil service, however, they are made tight by an inner coating of glue and if this coating is broken by rough and improper handling leaks will result. As a practical manual for the proper handling, care and storage of wood barrels, Oil-Power of the Socony-Vacuum Oil Co. had a series of photographs taken as reproduced here by special permission. Different parts of the barrel are identified in the drawing at the left, proper and improper methods of handling are shown on this page, and approved methods of storage, hoop tightening, tapping and emptying are shown on the next page. Directions for venting and tapping, both important to avoid damage and contamination of the product are given in the text

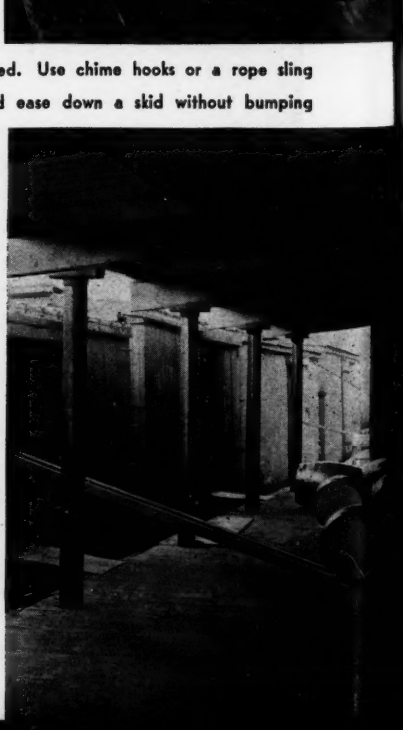






NEVER use a loading net to move wooden barrels for the barrels will invariably be damaged. Use chime hooks or a rope sling

DON'T roll a barrel on the edge. To avoid damage roll it on the bilge (center, below) and ease down a skid without bumping



HOW TO HANDLE WOODEN BARRELS

ROUGH treatment that may or may not dent a drum may leave the wooden barrel apparently undamaged yet leaking because the semi-resilient glue coating on the inside has been broken slightly. For this reason, a wooden barrel should never be permitted to drop even a few inches. When it is unloaded a skid should be used and the barrel should be "eased down" and not permitted to roll or slide freely.

If it is moved from place to place, it should be rolled on its bilge, using skids or a conveyor if the distance is more than a few feet, and it should be "eased" to a stop. If it is permitted to bump into another barrel, damage may be done. Damage may also be done by rolling barrels over cobblestones or tracks.

Barrels are frequently damaged in the course of loading and the chief offender here is the familiar loading net which inevitably results in broken heads and staves. Chime hooks or slings should be used. With the sling, approved practice calls for two barrels to a sling with an additional half turn around one of the barrels to prevent slippage.

Constant care should be exercised to avoid distorting the barrel, and a frequent source of damage in this way is rolling it on its edge (or chime). A barrel is designed to be supported on its bilge.

Wooden barrels stored in warehouses should be tiered on the bilges on skids and not more than four high with the bungs up. Skids of 2 by 4 in. lumber are satisfactory. The inside edge of the skids should rest on the outside edge of the bilge hoops on both ends of the barrel, the 4 in. surface lying flat on the surface of the barrel. Skids should be placed on the floor and between all tiers and tied together to prevent spreading.

The proper way to empty a barrel is to support it on its bilge, on a skid or rack, so that it drains through the bunghole by gravity. If it is desired to speed the flow, a vent may be bored in one of the heads after some of the content has been removed.

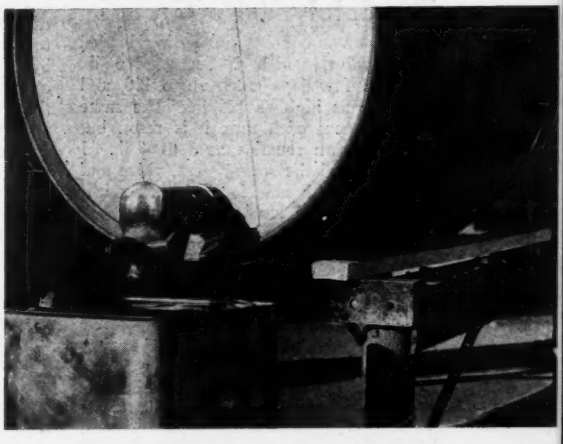
If this is done, great care must be taken to remove any chips or shavings and for this reason a vent made with a ten penny nail is preferable. This leaves no shavings and only slight damage done to the head. Contamination of product may be prevented by inserting a length of 1½ in. pipe in the bung.

An alternative method is to stand the barrel on its head, bore an opening in the head as far away from the bilge bung as possible, insert a tapered wooden spigot, faucet or gate. Then lower the barrel to its bilge position with the bilge bung up so it may be loosened or removed to provide a vent.

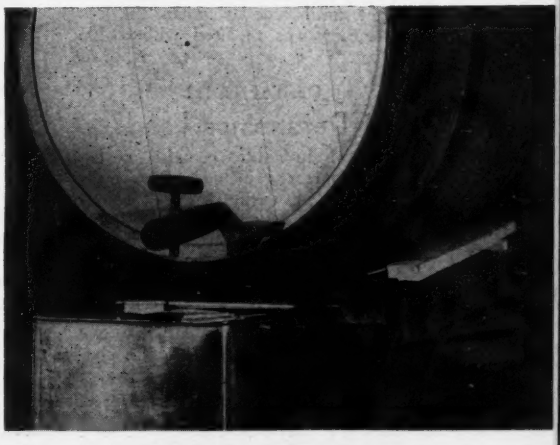
Care should be taken to make certain that any hole made in the head lies between the joints. Otherwise, one of the dowel pins that helps to hold the sections of the head together may be cut out and a weakened head and subsequent leakage will result. The hole should never be nearer to the chime than 1 in. If it is closer, forcing in of the spigot may break the wood. Care should be taken to remove chips or shavings. Boring holes in the head, for venting or for removal of product, is not a desirable practice and should be done only when actually necessary. The additional holes will impair the barrel for re-use until it is repaired.

Pumping from a barrel resting on its bilge is not satisfactory when speed is essestial, due to the short pump stroke. Standing the barrel on its head and boring an opening in the upper head permits the use of a pump with a longer stroke. The position will cause distortion, but this is not overly objectionable if the contents are removed within a short time. If the use of the barrel is to be continued over a fairly long period, it may be advisable to have the hoops tightened by "driving on" by an experienced cooper.

Support the barrel firmly on the bilge

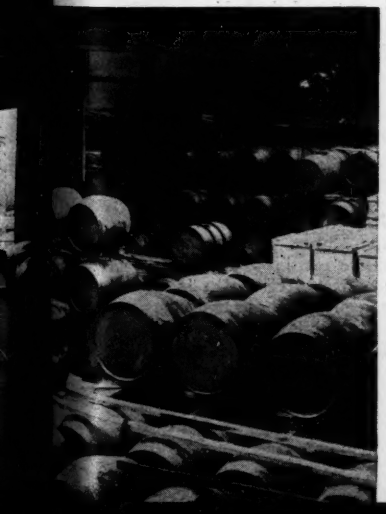


Tap the hole at least 1 in. from the chime

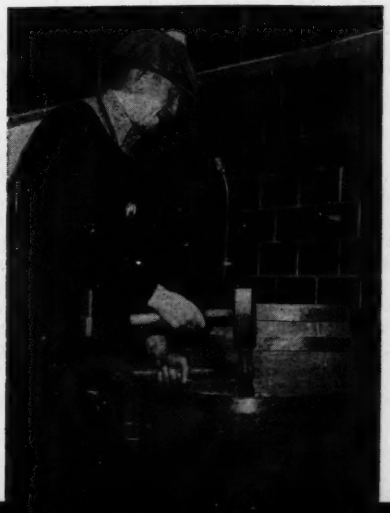


A homemade faucet, gate, or spigot may be used but the bung is often the handiest

Tier drums and barrels on skids tied together to prevent spreading



Judgment if needed here. Driving a bilge hoop more than ¼ in. may do damage



Questions And Answers

Question No. 161

The Safety Valve Creeps

WE HAVE one 3½ in. spring loaded safety valve, which if set at 105 lb. will in a few days creep up to 110, and has gone as high as 125 lb. The same thing happens each time it is reset, but the blowdown remains at 3 to 4 lb. I have replaced the spring, seat, valve and guide rods with new factory parts without success and have carefully checked it time and time again for a cocked spring, loose locking nut and bind points.

It has been suggested that the trouble lies in the pressure gages rather than the valve itself, but this is not possible because I have checked the gage against two others, one a master gage overhauled by the factory a short while ago.

Have other engineers encountered this trouble and if so what can be done to correct it? The valve is properly installed and the pipe supported. It worked all right until recently when the old 95 lb. spring was replaced with a 105 lb. spring. N. E. A.

Question No. 162

What Determines Lead?

WHILE I do not agree with all the opinions expressed in connection with Question No. 140 (printed on p. 91 November, 1941, answers on p. 96, 97 and 98 of the February issue) the subject is good and I will look forward to more indicator card material.

Now that the indicator card is back there is a question I would like to see debated in the P. E. & E.—not in connection with any particular make or type of engine, but steam engines in general. The question is:

What determines lead on any kind of steam engine?

East Bridgewater, Mass. L. B.

Question No. 163

Effect of Gases Dissolved in Feedwater

CAN you give us some information regarding the absorption of CO_2 in water, the removal of CO_2 and other gases from feedwater, and particularly the temperature at which the removal is most effective.

Battle Creek, Mich. W. R. H.

TWO GASES, oxygen and carbon dioxide, are considered to be the primary cause of corrosion in water systems. Water at 212 deg. F. containing as low as 0.05 m.l. per liter of oxygen has been shown to be corrosive. Also water at 212 deg. F. containing as low as 5 p.p.m. of carbon dioxide is likewise known to be corrosive. Corrosion is accelerated by increase in temperature. If both oxygen and carbon dioxide are present, the water is more corrosive than if only one is present.

These gases, however, must be in solution before they will cause corrosion to any extent. Dry gases are not noticeably harmful. Oxygen in water, amounting to 6 m.l. per liter at 70 deg. F. temperature is possible by absorption from the air.

Carbon dioxide in water comes from vegetable decomposition, absorption from the air, and industrial contamination. Carbon dioxide absorption from the air is small unless the water is quite acid. In some heating systems, the water has been degasified before it is admitted to the system, which usually removes all oxygen and some of the carbon dioxide.

All the carbon dioxide cannot usually be removed by degasification because it usually exists as ions HCO_3^- and $CO_2^=$. Even though all the oxygen might be removed from water going to the heating system infiltration at points under vacuum may build up the concentration. Concentration of high oxygen and carbon dioxide water forms in pockets in steam lines where gases can collect, be absorbed, and cause local corrosion.

It is advisable to degasify water by the use of a deaerating heater operating at a pressure around 5 to 10 lb. per sq. in. ga., using steam as a scrubbing medium. Theoretically, better gas removal can be obtained at the lowest operating pressure, for the lower partial pressure caused by the low operating pressure, has a greater effect than the increased solubility due to the lower temperature. However, it is advisable not to degasify below atmospheric pressure in order to avoid air infiltration.

Removal of carbon dioxide is a little more difficult. The carbon dioxide ionizes in water in inverse proportion to the hydrogen iron concentration. Thus highly alkaline waters have all their carbon dioxide in ion form and very little can be removed. Acid water has the carbon dioxide in a "free" form which can be removed.

The way to remove all of the carbon dioxide and oxygen is to acidify the water, remove all gases in a deaerator and then neutralize the water if necessary. Economic considerations generally indicate that acid treatment is not warranted. Deaeration to remove the oxygen and some of the carbon dioxide is usually found satisfactory.

Elliott Co. ALFRED AMOROSI
Jeannette, Pa. General Eng. Dept.

Question No. 164

Changing Fan Capacity

IF IT is practical, we would like to double the capacity of a ventilating fan used in connection with the cooling system in our theatre. Can you tell us what change would have to be made in the speed and whether or not this would be desirable from the standpoint of the mechanical design of the fan?

New York City O. A.

When operating against a constant system, the delivery or c.f.m. of a centrifugal fan will vary directly as the speed, in r.p.m. The static pressure will vary as the square of the r.p.m. and the horsepower will vary as the cube of the r.p.m. By constant system we mean that all ducts, dampers and other appurtenances, external to the fan itself, remain unchanged.

In the above case, and assuming that the system was left as originally installed, the speed would have to be doubled. In this case the horsepower would be eight times as great as that originally used.

It is highly probable in a change of this magnitude that it is planned to add additional cooling coils or otherwise alter the system. In this case the above ratios would not, of course, hold true and the actual requirements under these conditions would be obtainable only by calculating the overall resistance of the new system.

Generally speaking, it would not be practical to double the speed of the ordinary ventilating fan, although this cannot be set up as a hard and fast rule, since it would depend somewhat upon the original operating speed as compared to the maximum allowable speed for the given make and type of fan.

It is quite probable also that the noise level of any fan of this type would increase to a point which would make it entirely unsuitable for theatre operation should its output be doubled beyond the capacity originally selected.

M. W. BISHOP
American Blower Corp.
Chicago, Ill.

Question No. 165

Pump Proportions and Air Chambers

WHAT IS the ratio of the cubic space between: the top of the inlet valves and the bottom of the discharge valves of a reciprocating pump; and, the plunger or ram displacement? Is it common practice to have air vessels on reciprocating pumps? If so, what is the correct volume in proportion to the pump displacement?

Calgary, Alt. J. C.

THIS HAS been checked up with several pump manufacturers who state that there is no definite relationship between the two. You will appreciate that inasmuch as water is practically incompressible it makes little difference what this proportion might be from the stand-

point of efficiency of operation. In the case of a steam engine, however, this would be quite another question. The answer is, therefore, that this proportion varies widely with the various pumps on the market.

The second question is answered by the following paragraphs quoted from the Worthington Pump Handbook:

"In order to provide an efficient shock absorber in the discharge line, an air chamber is provided. Discharge air chambers are a necessity for single acting pumps of either the simplex or duplex type and for crank and flywheel pumps of any type. A discharge chamber is not necessary for duplex double acting low service pumps where the discharge pressure does not exceed 75 lb. per sq. in., or for small duplex double-acting pumps for general service (10 by 6 by 10 in. and under).

"The volume of the air chamber should be six to eight times the displacement for the single direct-acting or for crank and flywheel pumps. For duplex pumps the volume should be three to four times the displacement. Air chambers should always be provided with gage glasses and suitable air cocks on top as a means of releasing excess air and keeping the water level at the proper height."

Some means for supplying the air chamber with air, either from an air compressor or by means of snifter valves on the suction side of the pump, are essential since water will absorb the air in these air chambers and destroy their cushioning effect.

Question No. 166

Safety Valve Sizes

WE HAVE two identical boilers operating at 100 lb. ga. pressure and there is some difference of opinion as to whether or not larger or smaller safety valves would be required if the operating pressure on one of them was dropped to 15 lb. ga. Can you settle this argument for us?

Houston, Tex. H. A. REEVES

UNLESS the grate area or number of burners are reduced, certainly the safety valve requirements will not be reduced. Whether they need to be increased depends upon circumstances. The purpose of the safety valve is to protect the boiler against excessive pressures by having sufficient relieving capacity to handle the maximum amount of steam produced.

If the reduction in pressure is simply a matter of operating convenience, if the balance of the system would not be damaged by higher pressures, and if the load is such that the 15 lb. pressure can be maintained reasonably well by manual or automatic combustion control, the original safety valve capacity will be sufficient. In case of trouble the boiler pressure would simply raise up to the original pressure before the valves popped. However, if the pressure has been reduced due to the condition of the boiler or because of some low-pressure steam using equipment so that higher pressures would be dangerous, the safety valve pop pressure would have to be reduced and the capacity increased.

While safety valve capacities under the new boiler code have to be accurately rated by test and not size, the valve capacities were formerly calculated by formula, which is still a reasonably accurate guide for low pressure. One form of this formula for valves with 45 deg. bevel seats is:

$$W = 110\ P\ D\ L$$

Where W is the capacity in lb. per hr. of steam
P is the pressure in lb. per sq. in. abs. (gage +14)
D is the inside diameter of the valve seat in inches
L is the lift of the valve disc in inches

By assuming a value for W a relationship can be worked out between diameter and pressure, the lower the pressure the greater the diameter for a constant value of W and L. Inasmuch as the lift varies with the size of the valve (L is from 3 to 3.5 per cent of D) this mathematical relationship is rather confusing.

The difference in requirements is more apparent by assuming a given size valve and calculating the effect of diameter on the capacity. For instance a certain 2 in. valve has a lift of 0.07 in. The capacity as calculated for 115 lb. abs. is

$$W = 110 \times 115 \times 2 \times 0.07 = 1771 \text{ lb. per hr.}$$

For 30 lb. abs. (15 lb. gage) the capacity is—

$$W = 110 \times 30 \times 2 \times 0.07 = 462 \text{ lb. per hr.}$$

That is, reducing the pressure from 115 to 30 lb. has reduced the capacity approximately three quarters. This reduction is easily understandable if you consider that the volume of a pound of steam at 115 lb. pressure is 3.85 cu. ft. and at 30 lb. it is 13.75 cu. ft. In addition to the great increase in volume there is at the same time a reduction in the pressure forcing the steam through the valve.

A valve is of course nothing more than a very irregular nozzle or orifice and the flow through it (open) obeys approximately the same laws. As the back pressure is decreased the flow will increase until the critical pressure has been reached and will then remain constant. This critical pressure is about 58 per cent of the initial pressure. This would be about 66.7 lb. for an initial pressure of 115 lb. and 17.4 lb. for an initial pressure of 30 lb. absolute.

This critical pressure area in the throat of the valve or nozzle is where the steam velocity approaches that of sound, and the pressure approaches zero. The same effect on a smaller scale is used in the Venturi meter where the high velocity through the throat causes a reduction in pressure. Naturally if this velocity is increased to the point where the throat pressure is absolute zero, no further increase in flow is possible.

In the safety valve at 115 lb. pressure the 3.850 cu. ft. of steam is forced through by a maximum pressure differential of 115 — 66.7 or 58.3 lb. At 30 lb. pressure, 13.75 cu. ft. has to be forced through by a maximum pressure differential of but 30 — 17.4 or 12.6 lb. Therefore a given safety valve has a lower discharge in pounds per hour at low than at high pressures. If this were not true some of the modern million and half million pound boilers would be well buried under the safety valves needed.

Question No. 167

Steam Equivalent for Process Heating

FOR PROCESS WORK we use a closed, high pressure, water heating arrangement taking water from a boiler operating at 180 lb. ga. pressure. The temperature of the water leaving the circulating pump is 376 deg. F. and the return to the boiler is 350 deg. F. If the meter reads 2,000,000 lb. of water in 24 hr., how many pounds of steam at 180 lb. ga. would this be euivalent to and what would be the required boiler horsepower?

Milltown, N. J. S. S.

A. Neglecting the small amount of radiation from the boiler drum to the circulating pump, the temperature drop from 376 to 350 deg. F. represents a heat loss in the process work of 26 B.t.u. per lb. of water. $26 \times 2{,}000{,}000$ gives a total heat loss of 52,000,000 B.t.u. in 24 hr., or calculating by slide rule, 2,165,000 B.t.u. per hr. By definition a boiler horsepower is 33,479 B.t.u. per hr. so that the heat loss in the process work would be equivalent to $2{,}165{,}000 \div 33{,}479$, or 64.6 boiler horsepower.

What this 64.6 b.hp. would mean in terms of 180 lb. steam depends upon a number of assumptions. Assuming the temperature reading is more accurate than the pressure gage and that 376 deg. F. is the saturation temperature in the boiler, an additional heat input of 848.2 B.t.u. per lb. (latent heat) would form steam. Thus $2{,}165{,}000 \div 848.2 = 2535$ lb. of steam. This is the amount of steam that would have been formed from water at 376 deg. F. had there been no loss of heat to process.

It is obvious, however, that this method of calculation takes no account of the incoming feedwater temperature, and the fact that considerable heat had been put into the water to bring it up to the saturation temperature. The total heat content of the steam (376 deg. F. saturation temperature) is 1197.4 B.t.u. per lb. Assuming a feedwater temperature of 200 deg. F., the heat content of the water above 32 deg. F. (upon which the steam tables are based) would be 200—32 or 168 B.t.u.

The boiler would, therefore, have to supply 1197.4—168 = 1029.4 B.t.u. per lb. Therefore the heat used in process would have made $2{,}165{,}000 \div 1029.4$ or 2105 lb. of steam. If the process heat must be expressed in equivalent pounds of steam, we believe the latter method is preferable because it represents, for a given furnace heat input, the reduction in boiler steaming capacity caused by the abstraction of heat for process.

Question No. 168

The Turbine Blades Wear Away

WHAT causes wearing away or erosion of the final stages of a Parsons or reaction type turbine operating at 450 lb. steam inlet pressure and about 1½ lb. absolute back pressure? G. N.

WEARING away of the final stages of a turbine operating under the above conditions is probably caused by the abrasive action of the condensed steam and may have as much as 15% or more of condensed water entrained in the steam at the final stages of the turbine.

Many of the large machinery corporations building large turbines have devoted much time in research toward the solution of this problem. Stellite blades have been used in the final stages, special steels and coatings have been tried, but it seems there is nothing that fully combats the abrasive action of these moisture droplets traveling at high speed. Means devised thus far are not entirely satisfactory, and any enterprising engineers who can solve this problem will have his fortune made. On the other hand it may be one of the unsolvable problems of engineering.

Chicago, Ill. G. L. RADAMAKER

Question No. 169

Another Question About Power Factor

Q. A group of operating engineers were discussing the subject of power factor and the following question arose. While some thought it an improper question I am taking the liberty of putting it to you for such an answer as you may be able to give me.

The question is: with the following feeder loads and power factors, how, if possible, is the power factor of the generator supplying the feeders calculated?

Feeders	Amperes	Power Factor
1	85	84
2	20	99
3	14	77
4	10	60
5	40	72
6	35	60
7	50	94
8	22	62
9	43	65
10	45	90
11	75	90
12	115	90
13	5	73
14	55	90
15	80	100
16	140	91
17	50	79
18	150	88
19	25	93
20	80	68
21	72	72

None of the group were technically trained nor could we find the answer to this question in any technical publications at hand.

Paulsboro, N. J. EARL EVERLINE

A. The principles involved in the solution of this power factor problem are comparatively simple, but the actual numerical solution is a long and tedious procedure because of the large number of elements entering the circuit.

In any alternating current circuit the total reactive current is the vector sum of the reactive currents in the various branches.

Similarly, the total power current is the vector sum of the power currents in the various branches. This can be illustrated by a simple example.

Suppose we assume a circuit consisting of a synchronous generator and two motors, one, M, an induction motor and the other, M_2, a synchronous motor as shown in Fig. 1.

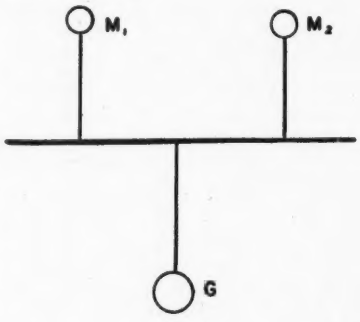


Fig. 1

The current drawn by the induction motor is assumed to be 30 amp. and lags the generator voltage E at an angle of 42 deg. Since the power factor of a circuit is defined as the cosine of the angle of displacement, this 42 deg. phase angle corresponds to a power factor of 0.74. This is obtained directly from a table of trigonometric functions.

The current taken by the synchronous motor M_2 is assumed to be 20 amp. and leads the generator voltage E by an angle of 25 deg. This corresponds to a leading power factor of 0.9.

These values of current are shown in their proper phase relationship by the vectors I_1 and I_2 in Fig. 2.

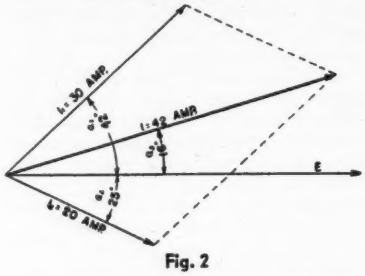


Fig. 2

Adding these two vectors graphically, by completing the parallelogram and drawing the diagonal as shown, we find the resultant current I to be 42 amp.—by actual measurement of the length of the vector.

By measurement also, the angle a_3 is found to be 16 deg. and since the cosine of an angle of 16 deg. is 0.96, the power factor of the system is 96 per cent.

The above is a graphical solution. The result can also be obtained by computation as follows, using simple trigonometry:

$$I = I_1 + I_2$$

$$= \sqrt{(I_2 \cos a_2 + I_1 \cos a_1)^2 + (I_1 \sin a_1 - I_2 \sin a_2)^2}$$

$$= \sqrt{(I_2 \cos 25° \times I_1 \cos 42°)^2 + (I_1 \sin 42° - I_2 \sin 25°)^2}$$

$$= \sqrt{(20 \times .9 + 30 \times .74)^2 + (30 \times .67 - 20 \times .42)^2}$$

$$= \sqrt{(18 + 22.2)^2 + (20.1 - 8.40)^2}$$

$$= \sqrt{(40.2)^2 + (11.7)^2}$$

$$= \sqrt{1616 + 136.9} = \sqrt{1753}$$

$= 42$ amp. *the same as before.*

This result, it will be seen, checks exactly with the result obtained by the graphical method.

To get the phase angle a_3

$$\tan a_3 = \frac{(I_1 \sin a_1 - I_2 \sin a_2)^2}{(I_2 \cos a_2 + I_1 \cos a_1)^2}$$

From above this is

$$a_3 = \frac{11.7}{40.2} = 0.292$$

From trigonometric tables 0.292 is the tan of angle 16.

Therefore, $a_3 = 16°$ *the same as before.*

This also checks with the graphical solution and of course represents a p.f. of 96 per cent lagging.

This then illustrates the method to follow in the complete solution to your problem.

In the foregoing example we considered the addition of only two currents, I_1 and I_2. If there had been 3 or 4 currents the total current I would be the vector sum of all 3 or 4 currents. Thus:

$$I = I_1 + I_2 + I_3 + I_4$$

Suppose these different currents are displaced from the generator voltage E by angles as follows:

$I_1 = a_1$
$I_2 = a_2$
$I_3 = a_3$
$I_4 = a_4$

The resultant I can then be calculated as follows:

$$I = \sqrt{(I_1 \cos a_1 + I_2 \cos a_2 + I_3 \cos a_3 + I_4 \cos a_4)^2 + (I_1 \sin a_1 + I_2 \sin a_2 + I_3 \sin a_3 + I_4 \sin a_4)^2}$$

The method is also shown graphically in Fig. 3.

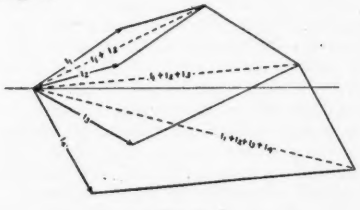


Fig. 3

Just to show you how to go about calculating your actual example, we have listed the values of cos and sin for the first 10 feeders as follows:

"BUBBLE, BUBBLE!"

Photograph in Nalco Laboratories, Chicago

TO SAVE YOU *toil and trouble*

THIS is the way Nalco technicians delve into the causes, effects and preventions of carry-over or foaming and priming of boiler water. And this is just one of a myriad of operations being carried out daily in the Nalco Laboratories. It's this ceaseless research that brings you feedwater treatment to meet your requirements—feedwater treatment that saves you toil and trouble and keeps your plant constantly operating at maximum efficiency.

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The Complete Water Treating Service

Nalco

Feeder	*Amp.*	*Cos.*	*Sin.*
1	85	.84	.54
2	20	.99	.14
3	14	.77	.63
4	10	.60	.79
5	40	.72	.69
6	35	.60	.79
7	50	.94	.34
8	22	.62	.78
9	43	.65	.75
10	45	.90	.43

For the first five feeders, therefore, your equation would be as follows:

$$I = \sqrt{(85 \times .84 + 20 \times .99 + 14 \times .77 + 10 \times .60 + 40 \times .72)^2 + (85 \times .54 + 20 \times .14 + 14 \times .63 + 10 \times .79 + 40 \times .69)^2}$$

This, we hope, will explain the method to you. As will be seen, it is quite simple, but the large number of feeders in your actual problem makes the actual computations long and laborious. It is much easier to simply connect a power factor meter to the circuit and read the power factor directly.

Answer No. 135

Cleaning Boiler Tubes

WHAT, asked Homer Hulsey, p. 94 of the October issue, is the proper method of using an air driven tube cleaner, should it be allowed to feed its way in or be worked slowly backward and forward, overlapping a little each time?

Specific answers to the question were printed on pp. 101-102 of the January issue and p. 95 of the March issue. The following is not a direct answer to the question, but it does throw considerable light on the role of management in tube cleaner operations and what can be done if the problem is properly handled.

Sets Up a Tube Cleaning Record

IF TUBE cleaning is put on a scientific basis instead of turning it over to the "black gang" it will pay lavish dividends. Two years ago one company was using as high as 500 drills per thermal cracking unit clean-out. This was at a tremendous cost of still tube steel. Recently two clean-outs were completed on the same units without the use of a single drill, and more important, no steel was cut. Cleaning time has been reduced by 75 per cent and the record to date is 58 motor-hours to clean some 9600 ft. of 3 in. I.D. tube. E.O.F.

Answer No. 140

What About the Indicator Card?

THIS QUESTION, sent in by A. A. Thieme of Richmond, Va., and printed on p. 91 of the November issue, asked for criticism of an indicator card from an 18 by 30 in. Hamilton Corliss, operating against 15 lb. back pressure in parallel with the utility system. When the card was reproduced the atmospheric line was accidentally omitted. A rule used to separate the illustration and text appeared to answer the same purpose, however.

This was noticed and commented on by A. H. Barnes in one of several comments published on pp. 96 and 97 of the February issue. He also remarked that inasmuch as the engine was supplying exhaust steam for process, considerable live steam was probably being used at the same time and under these circumstances any improvement in the performance of the engine would be of advantage primarily in connection with increased load carrying capacity and not so much from the standpoint of steam economy. The following letter refers more to Mr. Barnes' comment than it does to the original question.

Disagrees on Economy Angle

MR. BARNES certainly recognized the atmospheric line for what it was,—a phoney. I think, however, that he must be psychic for many engineers draw the atmospheric line of a card by pulling on the drum cord by hand. This gives a much longer line than would the engine stroke. I will omit some other observations regarding the card to get on to a subject that I consider far more important.

Why do so many engineers immediately jump to the conclusion that the economy of an engine is of no importance because the engine is exhausting against back pressure? To my mind it is like saying, what difference does it make how much I spend for beer, my week's pay goes anyhow.

While I am not acquainted with conditions in Mr. Thieme's plant the possibility exists that with a more economical engine, less utility power would have to be purchased (it might require some power factor correction) and an additional steam driven auxiliary such as an air compressor used to make up the supply of low-pressure steam required.

Also a high back pressure does not necessarily mean that the exhaust does not meet demand for process steam. Too often it is the other way round and a beautiful bloom of steam is blossoming from the exhaust head. That has been and still is the reason for more plants going over to purchased power than will ever come back.

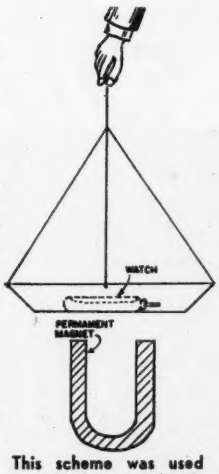
Melrose, Mass. E. MACDERMOD

Answer No. 141

His Watch Gets Magnetized

LEWIS SCHAEFFER'S question, on p. 96 of the December issue, on how to demagnetize a watch calls up memories of bygone times. In the early days of electricity, it was a common practice for watch makers to suspend a watch over a permanent magnet, as shown on the accompanying sketch, and twirl it while gradually drawing it away from the poles of the magnet. In the absence of more elaborate equipment, this is perhaps as good a way as any.

I believe that watchmakers now use a special demagnetizing transformer to correct magnetic trouble in watches, but I would suggest that Mr. Schaeffer place his watch near an ordinary transformer and then slowly walk away with it, and if that does not give the desired results, twirl it over a permanent horseshoe magnet.



This scheme was used by old-time watchmakers to demagnetize a watch

Long ago, in what now appears to be prehistoric times, I had a job as a draftsman in the old Duane Street Office of the New York Edison Co. Duane Street is a d.c. substation and one of my first jobs was to take all the outgoing d.c. feeders, then carried in vitrified ducts on the basement floor, and put them on a steel structure suspended from the ceiling.

This meant covering the ceiling with a heavy steel framework as each feeder was carried in a duct, nominally 5 in. square. The building beams were not of standard section and no two were parallel, so it was some job.

If one walked down between the lines of ducts on the floor with a bunch of keys in his hand, each key stood up on end. If he went up on a ladder and tinkered around the ceiling beams, he would likely find a hammer head clinging to one of them, owing to the strong magnetic field. You can well imagine what happened to watches under such conditions.

The rotary convertors were operated through a bank of three transformers with an H.r.t. (Induction regulator) and in order to demagnetize our watches, we used to walk up to an H.r.t. and then slowly walk away. Very likely an ordinary transformer would serve the same purpose.

Bloomfield, N. J. JAMES O. G. GIBBONS.

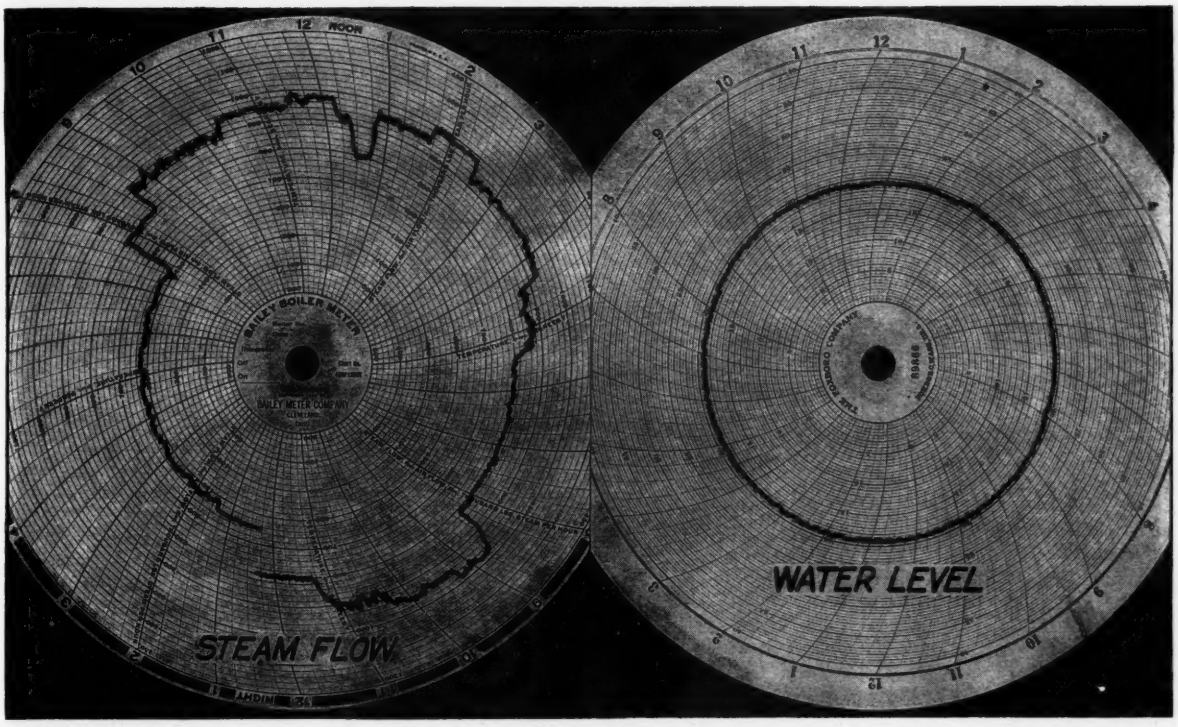
Two More Methods

THE WRITER has used two methods for this purpose. The first consists in suspending the watch, by a twisted and looped string through the stem, and allowing it to spin rapidly before the pole of a d.c. generator. The second consists in providing a coil wound on a wooden form, with an opening large enough to insert the watch. The coil is excited from a 60-cycle circuit.

A demagnetizer of this form is in common use at watch repair establishments. Where a.c. is not available a motor-driven commutator is used. This gives a reversed d.c. current to be applied to the coil to obtain the demagnetizing effect. A coil with 200 turns of No. 20 magnet wire in series with a 100-w. 120-v. lamp has given good results.

It is assumed the questioner has already considered the question of using a non-magnetic type of watch.

Brooklyn, N.Y. C.O. VON DANNENBERG.



These charts show why 7 plants in this utility system use Flowmatic

This utility system first installed COPES Flowmatic in 1937. Now seven of its plants are using this simplified two-element steam-flow type feed water regulator on 875-pound pressure boilers, with capacities from 400,000 to 550,000 pounds per hour. Nine repeat orders have been placed. The charts show why.

This Foster Wheeler 3-drum boiler normally evaporates 330,000 pounds per hour, with maximum load of 400,000 pounds. Fired with powdered coal, total temperature is 860 degrees F. The motor-driven centrifugal pump has no automatic pressure control, yet the water level is held within less than plus or minus one inch by the COPES Flowmatic.

Want to know how this new COPES operates—where it is used—what results others are getting in regular service? Then write for Bulletin 429. It's worth your study!

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LETTERS AND COMMENTS

More Dope on Dew Points For High Sulphur Fuels

IN THE February, 1942 issue of POWER PLANT ENGINEERING, p. 64, there appears an article on Exhaust Gas, Dew Points and Engine Lubrication by Bill Maddock. In the second column on p. 65 the author discusses the need for setting the lower limit of gas temperature at 70 to 100 deg. F. above the calculated dew point, the dew point being calculated as 125 to 150 deg. F.

It appears that when sulphur products are present there is considerably more to the dew point calculation than was covered in Mr. Maddock's article. When all factors are included the calculated dew point will be much higher than indicated by his Fig. 1.

In recent years I have been considering dew point calculations in the light of a paper by Jesse S. Yeaw and Louis Shnidman entitled "Flue Products of Industrial Fuels." This paper was published in Industrial & Engineering Chemistry for September, 1936, pages 999-1004. From a practical point of view the same final answer on gas temperature may be obtained by Mr. Maddock's system as by the Yeaw-Shnidman system. However, the latter method seems to me to be the more rational way of accounting for sulphur products.

Detroit, Mich. MAX W. BENJAMIN

Tsk! Tsk! Mr. B. This Is Heresy

MAY I congratulate you on the timely editorial, Ritual on page 51 of the March issue. You are entirely correct in your analysis of the methods and procedure of large engineering conventions and it is gratifying to note that you have had the courage to speak out and turn the light on a practice that has long been in need of constructive criticism.

The manner in which most technical programs are handled and carried through by most of our leading engineering societies leaves much to be desired. There is entirely too much railroading of the technical programs, too many papers and too little time for discussion. In recent years, this writer has presided as chairman of some three or four sessions of meetings, the programs of which were overloaded and the time short.

In each case I was cautioned by the society's secretary that the session must proceed on schedule, that discussions of the papers must be shut off when the predetermined time to be devoted to the discussion of any given paper was up, and that the session must close on schedule in order not to interfere with something that was to follow.

The net result of such procedure is a high-pressured and hurried session with but little, if any, opportunity for those not on the program to develop a discussion that would bring out many important and fundamental points.

Yes, we seem to be going high hat, highly technical and over-efficient and to be losing sight of the real aims of our national society meeting programs. If we continue to follow the Ritual as you have so clearly discussed in your excellent editorial, we are quite likely to "miss the boat."

Atlanta, Ga. C. T. BAKER
Consulting Engineer

Electric Couplings on Fan Drives

EDITOR'S NOTE: On page 48 of the January issue the John Morrell & Co. power plant extension was described. The plant operates in parallel with the utility system on a power interchange agreement. Variable speed dual drive was used on both the forced and induced draft fans; on one end a steam turbine driving through a magnetic clutch; on the other a constant speed motor driving through a variable speed electric coupling. Both drives are controlled by the automatic combustion control system which also incorporates equipment for synchronizing when changing from one drive to another. Questions regarding the economics of this drive on a boiler of 100,000 lb. per hr. were referred to the consulting engineers, the answers follow.

FIRST, the fans were dual driven in the way that they were to insure absolute reliability of power for driving the fan, or, in other words, an absolutely reliable source of fan power was primary and cost was secondary. There are long periods of the year when the entire steam load is carried on one boiler and it has been our experience that the weak point in this arrangement has always been the matter of air for the pulverizers and draft.

For example, with No. 2 Boiler (older unit) where this arrangement is not available the plant has had to be shut down two or three times due to lack of steam which was brought about by failure of the driving unit on one of the fans. Second, in order to assist the heat balance of the plant throughout the various hours of the day and various days of the week it is desirable to switch from electric to turbine drive on the fans, or vice versa.

Unless the fans are dual driven and connected as they are on No. 3 Boiler (new unit) it would be impossible to do this without shutting down the boiler. With the boiler carrying all of the load the shift of the fan drives would not be possible for heat balance purposes, if the boiler had to be shut down in order to make the shift.

The variable speed couplings on the motor ends were put in principally for power economy at decreased loads and before the Morrell job was put in we used practically the same fan drive hookup on The Rath Packing Co. job except that there is an hydraulic coupling instead of the electric drive. The clutches on the turbine end were put in to give a physical disconnect and eliminate losses on the turbine while the motor was in use, and, to allow the turbine to be worked upon.

DAN S. HELMICK
Helmick, Edeskuty & Lutz,
Minneapolis, Minn.

Grounded Distribution Circuits

ADVANTAGES of Grounding Distribution Circuits by H. A. Peterson, on p. 93 of the February issue, covered the theoretical features clearly. Actually for low voltage circuits, 600 v. and less, troubles due to surges in the writer's experience have not been severe due essentially to the margin in the insulating features of the equipment.

One particular feature of value in the grounded system is the fixed value of the voltage to ground while in the ungrounded system the value may vary over practically the whole range of the value between lines due to the relative relation of each line to ground. This is a most important and valuable feature of a grounded system.

It is argued that in a grounded system there may be more interruptions since contact of any conductor with ground may cause an excess current flow to ground. Actually due to this possibility it is usual to have just as good operation with a grounded system due to the necessity of keeping up the insulation to ground and remedying a fault as soon as indicated. The advantage so-called of possibly being able to operate for periods, in an ungrounded system, with one conductor grounded, is a doubtful one.

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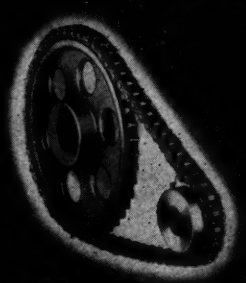
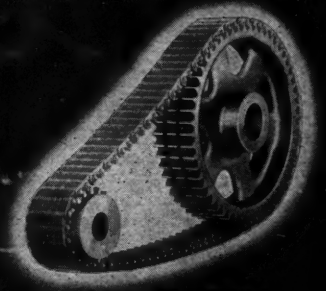
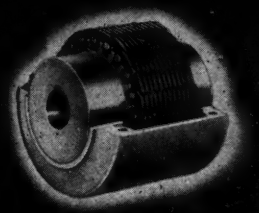


1 Morse Roller Chains



2 Morse Silent Chains



4 Morse Silent Chain Couplings

3 Morse Indexing and Free-Wheeling Clutches

5 Morse Morflex Couplings

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In these days of "all out" production, the job of efficient, dependable power transmission becomes extremely important. Power loss through inefficient drives can seriously effect your production schedules. Insure against production set-backs by transmitting all the power with Morse Drives. Regardless how large or small your drive requirements may be—Morse Drive equipment will meet your needs more efficiently and economically. Morse Silent and Roller Chains have many exclusive features. They deliver at 99.4% efficiency. Don't overlook the many advantages of Morse Silent Chain and Morflex Couplings. They are dependable, long lasting and have proven themselves worthy in hundreds of different installations under the most severe conditions. Morse Indexing and Free-Wheeling Clutch Couplings are ideal for indexing and free-wheeling purposes—available in many sizes. You will profit with Morse Drive equipment—consult the Morse man in your territory—today.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS

MORSE *positive* DRIVES

MORSE CHAIN COMPANY ITHACA N. Y. DIVISION BORG-WARNER CORP.

This is particularly true of an extensive system in the higher voltages where the charging current to ground may start a progressive breakdown of the insulation which when it finally develops into a real fault may cover quite an area. A ground fault on a grounded system must be corrected at once and can be readily provided for in protective devices.

It is of interest to know that 3-ph. grounded circuits can be fully protected by means of two relays to take care of all line to line faults and one relay for all ground faults.

Brooklyn, N. Y.

C. O. VON DANNENBERG

If Promotion Is Too Slow, Read This

RECENTLY a chief engineer retired and recommended his assistant as his logical successor. In substance, his explanatory comment was "You are not gambling with this man; I've learned considerable from him, for, besides his good engineering background he is not one who remains static. He is a diligent student of the engineering papers, and he taught me how to solve power plant problems through their proper use!"

There was no doubt or uncertainty as to the proper choice, in the mind of the retiring engineer, and he had good reason, appreciating the progressive possibilities represented by the engineering periodicals. What a contrast to another plant where one of the younger engineers was once chided for spending too much time reading such periodicals! Indeed, how many of the engineering fraternity can attribute considerable to the engineering publications for their present high positions? Meanwhile, others, less opportunistic and less foresighted, remain in minor niches.

Some young engineers may feel peeved because they do not get ahead rapidly enough. Of course, there are divers factors governing power plant promotions, but do such worried members ever ponder the possibilities represented in the engineering periodicals, and is it their unvarying practice to utilize all contents fully?

Some of the less thoughtful will accord scant perusal to promotive publications; indeed, it is a question whether they digest full value from a thought-provoking discussion of an engineering topic when they do read it. When an individual is steeped in skepticism of the importance of such instructive and useful information, it can hardly be expected that he will do full justice by it.

Contrarily, consider how one ambitious engineer utilizes his engineering periodicals. He reads them from stem to stern. He finds out things of new engineering products that others, less concerned, though higher positioned in the same plant, know not a whit of. Superiors sometimes are amazed at his grasp of some new engineering equipment or additional featured unit that the plant might well acquire. He in turn will stoutly sustain his recommendations with unequivocal facts and figures that leave no room for dubiety so his counsel, while not always followed, invariably receives weighty consideration.

Even though a given advertisement or article is not immediately followed up, he clips them for systematic filing in large and small envelopes alphabetically arranged so that they are available for reference. He knows where desirable information is available, and he makes it his rigid policy to capitalize on the potentialities, to the advancement of not only himself, but also the plant which employs him. Props up a problem for which he does not know the solution; he is certain to get it, somehow or other, by aid of his engineering material. He takes pride, and rightly, in helping others solve problems.

He refers articles on vital and timely topics to staff members, and plays his part otherwise in seeing to it that the concerned matter receives its due consideration. Frequently meetings, on his initiative, are staged for the purpose of discussing a certain subject covered in an article and pertinent to some plant problem. At the termination of such a get-together, the individual members are usually wiser and the organization usually is in a position to take confident and positive steps on the subjects mulled over.

Brooklyn, N. Y. FRANK V. FAULHABER

Accidents to Standby Equipment

ON PAGE 78 of the February issue, Mr. Brown, in his article, "Utah Municipal Plant Maintains Good Operating Record" brings out a very important point. He says: "The centrifugal pump installed with Unit No. 3 is a turbine driven emergency pump and is started occasionally only to keep it in good operating condition."

Failure of operating men to appreciate this factor in connection with machinery that lies idle for some time, is a potential hazard for it may well be found inoperative when needed.

For instance an injector is a poor reserve for a boiler feed pump if you let it lie idle too long. Scale will accumulate in the steam line and stop the nozzle. Therefore if an injector is a standby it should be tested out say once a week to see if it functions.

If you have an extra boiler in reserve, it is wise to use the boiler and give it a regular tour of duty as we find sometimes that machines deteriorate more from lying idle than if given a reasonable amount of service. In a plant having three boilers of the same size, one was habitually left out of service, and empty of water. The boiler inspector on opening it up found that its stop valve had been leaking and had allowed a cloud of steam that had badly rusted it inside, particularly on the flues, which when hit by the hammer shed a shower of large scales.

In another case an idle boiler on being fired up, was found with the safety valve inoperative. Upon examination it was found that a mud-dauber wasp had built a nest inside the outlet to the valve. When a boiler has been out of use for a time it is always in order to test the safety valve as soon as you have steam, as in the idle condition they are more liable to stick fast on their seats.

All kinds of plant auxiliaries should be tested out regularly to insure that they are in working order. This refers also to electrical machinery. We ran onto a case where a plant in a hot moist climate had two rotary converters, and one was allowed to stand idle and not given its tour of duty. It was left covered with a tarpaulin and moisture coming up through the wire duct from the basement condensed on the windings. When hastily started for emergency use, the insulation broke down and there was an expensive repair for re-winding necessary. If the machine had been in regular tour of duty, it would have been free of moisture.

In marine engineering, ships are sometimes laid by for a winter period and everything must have a thorough overhaul before putting in service in the spring. Glands must be re-packed and pumps and other auxiliaries must be thoroughly overhauled and tested out. If you are starting up a small steam engine for the first time, it is better to turn it over by hand first to see if there is any undue friction.

Here is a case of damage to a brand new 500-hp. engine bought to be belted to an electric generator. The engine was tested and performed nicely, but there was delay in shipping the generator. A period of 3 wk. elapsed before the generator was put in place and belted up.

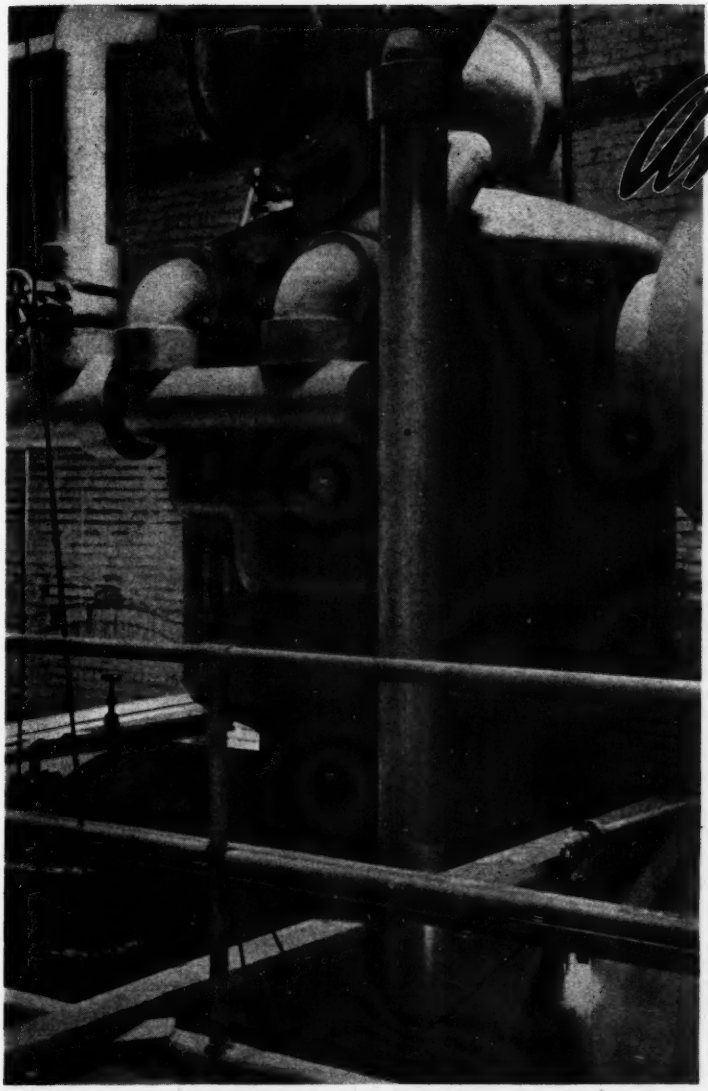
The engine had Porter-Allen admission valves and Corliss exhaust valves. The engineer turned on the steam and the eccentric driving the steam valve, and the exhaust crank, broke. After the engine was taken apart it was found that the stop valve had been leaking steam into the cylinder and all the valves had rusted fast onto their seats.

A sledge hammer had to be used to drive the exhaust valves out of their ports so they could be cleaned of rust. There were marks in the cylinder to show that the piston rings had rusted fast to the bore.

If this engine had been started up under steam each day during its idle period and run for a few minutes and given a good shot of cylinder oil by a hand pump as it was being shut down this would never have happened.

Another case of an idle boiler feed pump will probably be instructive. This pump, after being idle for some time was started up. After making about a half-stroke it stopped, and, although one could hear the steam blowing through she would budge no further. On taking the pump apart it was found that the single piston ring on steam piston had rusted fast in its groove and failed to expand out. The piston had moved forward a little way to a place where the larger bore of the worn part of the walls let the steam by and here it stalled.

Here is a case of, shall we call it "sabotage," of a number of ventilating fan motors in a large cold storage sys-



Another COCHRANE DEAERATOR *in the ranks of the Paper Industry*

238,000 lbs/hr unit at Rhinelander Paper Co.

COCHRANE water conditioning equipment has a brilliant record in the paper industry. Where so much of the process depends on water, its purification both for steam generation and for process work is mighty important.

The recent addition of a new 5000 kva turbine-generator and a 100,000 lbs/hr boiler to the power plant of the Rhinelander Paper Co. at Rhinelander, Wis., illustrates this point.

The feedwater of the new boiler is chiefly returned condensate, make-up averaging about 25%, this being raw river water, sand-filtered and treated.

A Cochrane Deaerator of 238,000 lbs/hr capacity, raises the feed-water temperature to 235°F and reduces the oxygen content to zero cc/1. From here the water enters the economizers at 235°F and is raised to 400°-420°F before entering the boilers.

Many of the greatest names in the pulp and paper industry are numbered among Cochrane's customers. A complete list of installations will be sent on request as well as a copy of Publication No. 3005 describing Cochrane Deaerators for all industries.

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tem that had temporarily shut down its refrigeration equipment during three cold months. In starting up the fans about half of the motors promptly burned out.

It was found that the air going through the ventilating ducts had left moisture in the motors. These motors were installed wrong, of course, for the motors should have been put outside the duct. If the motors had been started up once a week and run for a few minutes till they got warm this would probably not have happened.

The moral of these stories is that sometimes machinery will depreciate faster when lying idle than when in normal use and it is up to the engineer in charge to look out for such conditions that cause trouble. We know of an old experienced engineer who had a new engine that was temporarily disconnected from its steam line and he turned it over by hand every day to be sure it did not rust fast anywhere.

We will tell one more story of typical interest. Part of a factory had been abandoned leaving a battery of water tube boilers presumably in good condition and offered for sale. A prospective buyer hired a boiler inspector to go look the boilers over and report their condition.

We found there was a line carrying hot water over the top of one of the boilers and this had sprung a leak at a flange joint. The leak was small and had escaped attention, but it dripped on the boiler setting and ran down over the flues inside. Some of them were rusted so badly that about 20 had to be replaced to put the boiler in first class condition.
Logansport, Ind. C. C. CUSTER.

Safety in Welding

THERE is a very definite need for a fuller appreciation of the need for safe handling of welding equipment both of the arc and acetylene type. This includes both personal safety and the safety of equipment due to the fire hazard.

Recently we have had one of our forced draft fan motors catch fire. This was caused by an employee cutting structural steel above the motor. Through fast work and some luck we were able to put out the fire without damage to motor, except to take boiler out of service for a little over an hour.
Bismarck, N. D. LESLIE BRADLEY

A Too Little and Too Late Parable in Blank Verse and Purple Glass

RECENTLY a number of chiefs, plant engineers, and others, have been bemoaning the fact that their valued assistants have left to accept positions offering better money, and there is considerable difficulty in filling the vacancies with competent men of the desired type.

On gathering a few of the details, a typical summation of what has happened runs about as follows:

Assistant has hinted, the buzz ranging from the very gentle to the "or else" variety, that an increase would be welcome due to rising living costs, etc.

Boss has discounted hired hands' plea as a bluff, attempted holdup, or subtle blackmail.

Boss figures he can't get a raise for himself, why get an increase for his stooge.

Boss having some ideas of his own about how expenses should be kept down, does not go to bat for wage slave, with the management.

Flunkey, who has been digging himself into debt or is nearing the bottom of his sock, starts looking around and applies for a job he hears about that pays maybe ten bucks more than he is now getting.

Management receives an inquiry from prospective employer about hireling's qualities and are surprised. "Why Zany has been with us for years."

Boss is called in on carpet for "how come."

Boss has difficulty explaining why he did not let management know that so-and-so was dissatisfied with his pay (i.e. brass-hats' buck-passing, as no one is ever satisfied with their pay).

Boss is informed that in the future to present these cases to the management for consideration, with his recommendations.

Boss is informed to inform, magnanimously, the toiler that his stipend has been increased by two-fifty.

Boss reaches new heights of eloquence in telling, with gestures, the worker that as a result of his, the boss', determined and untiring efforts that the management had consented to his giving the said worker a two-fifty raise.

Worker counters by saying that while he, the boss, was up on the bridge he, the worker, had received a phone call asking him to report for work a week from next Monday, and that he had said he would be there.

Now for some back-geared philosophy:— If the worker's not unreasonable request had received the consideration it was due, the raise would undoubtedly have been forthcoming, the worker would have been satisfied (for the time being) and he would not have started to nose around. Furthermore he probably would not have even considered an outside offer at more money as a "known devil is better than an unknown one."

But, his request not bearing any results and probably not even an excuse, the man became dissatisfied in addition to being worried and developed a new job complex and likely would not have stayed had the management offered to meet the salary the new job would pay. In the long run the worker might have been better off in his old job with the slight increase, but that is mere conjecture.

Meanwhile the boss is in a fix, his organization is shot, he can't get the type of man he wants and is accustomed to having, and things are not as smooth as they formerly were. In addition the management is giving him the eye lately, probably because of the delays in completing long requested and essential work, and also, because they are wondering if he can handle help the way they thought he could because he had told them so.

Maybe this doesn't happen in other sections of the country though and is merely an expression of Bean & Cod individuality, or, mayhap, it is our inherited Bay State hebetude.
Melrose, Mass. E. MACDERMOD

Are You a Success? If Not, Try This Personality Polishupper

HE MUST be a man of vision and ambition, an after-dinner speaker, a before and after-dinner guzzler, a night owl—work all day, drive all night and appear fresh the next day. Learn to sleep on the floor and eat two meals a day to economize on traveling expenses.

He must be able to entertain customer's wives, sweeties and pet stenographers without becoming too amorous. Inhale dust, drive through snow 12 ft. deep at 10 below and work all summer without perspiring or acquiring B.O.

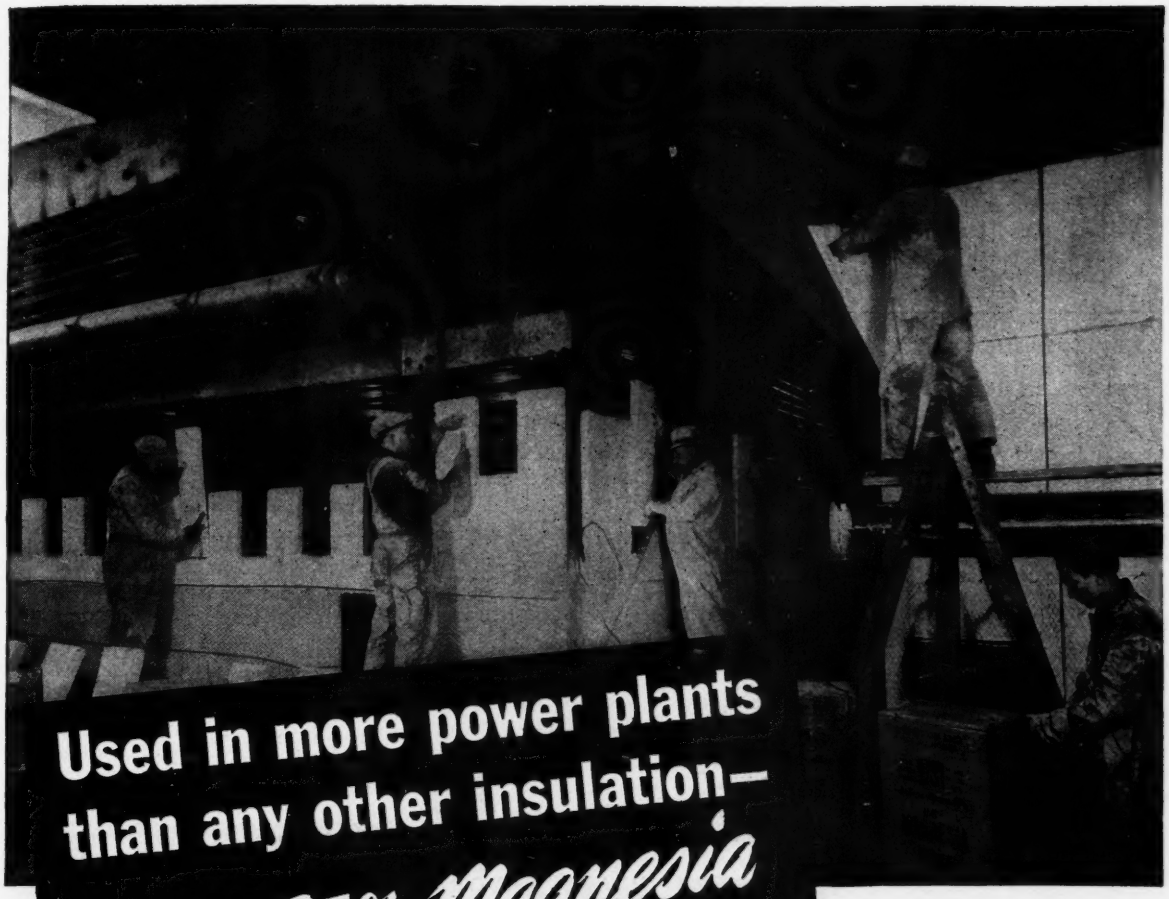
He must be a man's man, a lady's man, a model husband, a fatherly father, a devoted son-in-law, a good provider, a plutocrat, Democrat Republican, a New Dealer, old dealer and fast dealer—a technician, electrican, politician, machinist, mechanic, polygamist and ambidextrous.

He must be a sales promotion expert, a good credit manager, correspondent, attend all jobber clinics, dealer meetings, labor union meetings, tournaments, funerals and births, visit customers in hospitals as well as jails. He must contact all accounts every week and in spare time look for new business, collect delinquent accounts and do missionary work.

He must have a wide range of telephone numbers when entertaining any visiting executives.

He must also be an expert driver, talker, liar, dancer, traveler, bridge player, poker player, toreador, golf player, diplomat, financier, capitalist, philanthropist, nudist, and authority of palmistry, chemistry, archaeology, psychology, physiology, meteorology, criminology, dogs, cats, horses, trailers, blondes, redheads and lingerie.

Editor's Note: The author of this remarkable bit of psychological and vocational research is unknown for it was distributed anonymously at a meeting of the Great Lakes Power Club as an outline of the Requirements of a Successful Power Sales Engineer. Investigation indicates, however, that it is the universal personal success formula, for everyone, regardless of profession, feels it defines the requirements of his job perfectly. For those interested in polishing up their personality, we present the outline as an introduction to the more serious study of How to Win Bets and Influence Horses. The Turf Editor reports that work on this monumental volume has been held up due to technical difficulties involving quadruped noncooperation.



Used in more power plants than any other insulation—

J-M 85% Magnesia

For power-plant service up to 600°, it's a habit with engineers to specify J-M 85% Magnesia Blocks and Pipe Insulation.

It's a good habit, too, they'll tell you, for no other material provides such satisfactory performance on the job. That's because J-M 85% Magnesia delivers the right combination of long life and high insulating value that means *permanently* efficient, economical service.

And it's easy to install, for it is light in weight, readily cut and fitted. For details, write Johns-Manville, 22 East 40th St., New York, N. Y.

A Few Other J-M Insulating Materials

For cold rooms, ducts and refrigerating equipment—
Rock Cork Sheets

For refrigerated piping—
Rock Cork Pipe Insulation

For cold-water lines—
Anti-Sweat Pipe Insulation

For hot or cold service-water lines—
Pre-Shrunk Wool Felt Pipe Insulation

For low-pressure steam lines—
Pre-Shrunk Asbestocel Pipe Insulation

For steam lines to 700° F.—
Asbesto-Sponge Felted Pipe Insulation

For superheated steam lines—
Superex-Magnesia Combination Insulation

For furnace insulation—
Superex Blocks, Insulating Brick (3 types), Insulating Fire Brick (4 types), Sil-O-Cel C-3 Concrete

Other insulations for special requirements

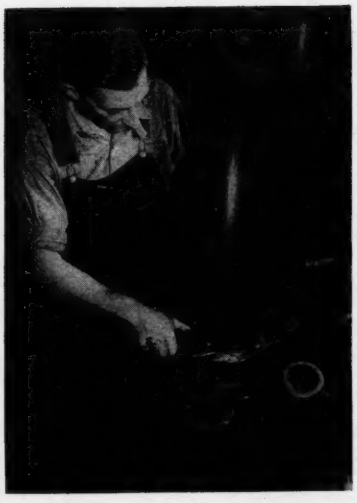
Johns-Manville INDUSTRIAL INSULATIONS

FOR EVERY TEMPERATURE...EVERY SERVICE CONDITION

SHOP TALK

A department showing by means of photographs how engineers in various plants have overcome certain obstacles or devised methods to facilitate operation. If you have done something along similar lines that you are proud of or which you feel may be of interest to others, send us a picture and a paragraph of explanation. If the photograph is good and if the idea is original we will present it on this page and pay you for it.

ORSAT LIGHT. Heating engineer Albert Stultz of the Equitable Gas Co., Philadelphia, had difficulty in taking orsat readings in dark basements and boiler rooms. He fixed this up very neatly by an arrangement of five flashlight bulbs connected to a single battery and operated by a push button. Other engineers in the Utilizations Engineering Department of the company have tried it and approve of the ease of reading, improved accuracy and saving in time which it gives.

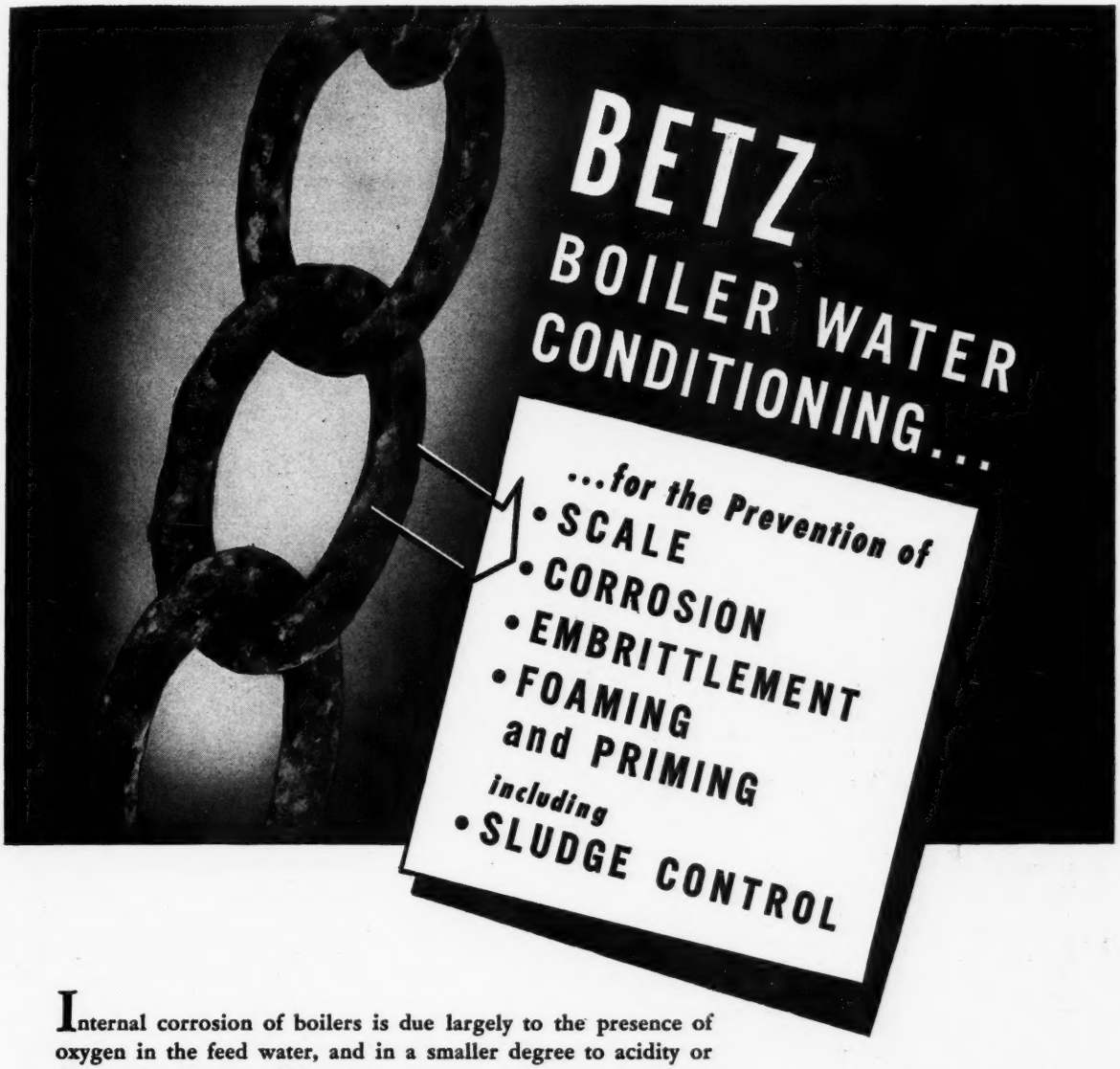


ELEVATOR PLUNGERS. Walter Johnston shows how to finish up a repacking job properly by turning the gland nuts down only finger tight. The 9 by 7½ by 3⅞ in. box with J. M. Sea Rings subjected to 130 lb. pressure has not been repacked for nearly 2 yr. and is still going strong. Formerly the plungers were repacked every 3 mo. Walter is the son of Charles Johnston, Chief Engineer of the Boggs & Buhl Department Store in Pittsburgh, Penn.

PLANT LABORATORY. Water treatment is admittedly one of the most important of present day problems and proper control by frequent plant check tests is essential regardless of the treatment used. These simple tests do not necessarily require an expensive laboratory. This photograph shows the simple but well arranged laboratory in one of the boiler rooms of the R. C. A. Mfg. Co. plants.

SQUIRREL ELECTROSTAT. Vernon W. Palen, among other things veteran collector of oddities, of Eau Claire, Wis., found this tragic example of the wages of carelessness in the hinterlands of Wisconsin. The squirrel did not read the "Shop Talk" page in the January, 1942 issue and paid for this oversight with his life. Inasmuch as it took some little effort to pry the jaws from the top wire, Mr. Palen assumes that the squirrel was sharpening his teeth on the hot wire while his body came in contact with a bare spot on the middle (neutral) wire. From the engineer's standpoint "the tragedy did not interrupt service on the line."

AMMONIA PUMPOUT LINE. Ammonia nuisance from pumpout discharge is eliminated at the John Morrell & Co. meat packing plant at Ottumwa, Ia., by means of the two water spray heads as shown by the photograph. The sprays, arranged to give a complete curtain of water around the pipe stops any nuisance.



Internal corrosion of boilers is due largely to the presence of oxygen in the feed water, and in a smaller degree to acidity or dissolved carbon dioxide. Even after external treatment, these corrosive agents may still be present in damaging amounts. In the solution of corrosion problems Betz engineers depend upon no rule-of-thumb panacea; they first search for and find the cause, then apply the proper combination of corrective chemicals to prevent further destructive action.

Now, as never before, with all industry under the necessity of attaining the utmost in production with available plant and personnel, the matter of correct water conditioning becomes primary in importance. In this vital field Betz stands ready to render a complete service . . . of consultation, research and supervision.

Rem-Ox, Betz technical Sodium Sulfite for oxygen reduction is now available for prompt shipment. Write for information and prices.

W. H. & L. D. BETZ

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

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REPRESENTED IN ALL INDUSTRIAL AREAS OF U. S. A. AND CANADA

EMPLOYER'S WARTIME RESPONSIBILITY

Gordon L. Hostetter, Director of The Employers' Association of Chicago, says that every employer must achieve a system of business and industrial discipline to insure operation at top efficiency

NO EMPLOYER should assume that, because his business is not in the direct production of munitions or other first line war materials, that he does not share in wartime responsibility for enemy espionage and sabotage activities which may be directed through unexpected channels at completely unexpected times.

In maintaining full business and industrial efficiency and guarding against espionage and sabotage, the most important single factor is securing the loyal and intelligent support of employes. The necessity and nature of emergency methods should be thoroughly understood by every worker, not to stimulate a hysterical spy hunt but to apply the sensible methods of business organization to the current national problem.

All employers should adopt extra precautions in hiring new employes. The reference form should include, in addition to the standard personal records, the following specific information: If foreign born, full data on entry into the United States; for naturalized citizens, when and where naturalization papers were obtained; names and addresses of employe's immediate family, relatives of husband or wife, and close relatives residing in a foreign country; military or naval experience in the U. S. or with a foreign power; organizations other than labor unions to which the employe belongs; employe's record during the period from 1914 to 1918.

In addition to new employes, the above information should be secured from key employes and, in some cases, from all present employes. Data given should be checked insofar as possible.

Industrial plants, public utilities, and other businesses vital to the national defense should fingerprint all employes and new applicants for jobs. Fingerprint records should be sent to the Federal Bureau of Investigation to check for criminal records. During the wartime emergency, absentees should be checked to verify the reason for absence. Persons absent without legitimate excuse should be regarded with suspicion.

Special rules for employes, including the precautions against espionage and sabotage, should be furnished to all employes and applicants for jobs should be required to sign the rules as evidence of familiarity with them. In addition, printed copies of the rules should be conspicuously posted, together with copies of the Federal Espionage and Sabotage Statutes.[1]

In order to make other precautions really effective, all vital industries and businesses should adopt an identification system which will be adequate at all times and under all circumstances to prevent unauthorized persons from gaining access to strategic points.

In concerns which work on confidential material, special precautions should be taken. Careless handling of both incoming and outgoing mail should be safeguarded against by all employers, including concerns which may not deal directly in primary war materials but may have correspondence with firms which do.

It is particularly important that special thought be given to the proper safeguarding of plant and building entrances such as coal chutes, fire-escapes, skylights, sidewalk elevators, shipping and receiving platforms, storm sewers, and windows facing on streets and alleys. All such points should be adequately protected. In addition, it may be desirable to install floodlighting systems to prevent trespassers from reaching such points unobserved, and suitable interior lighting is recommended when the property is not occupied.

Rules and regulations covering smoking, handling of inflammable materials, and other standard precautions against fire should be rigidly enforced. Redoubled attention should be given to the facilities and organization within the property for dealing promptly with a fire when it has occurred. Adequate first aid provisions are essential.

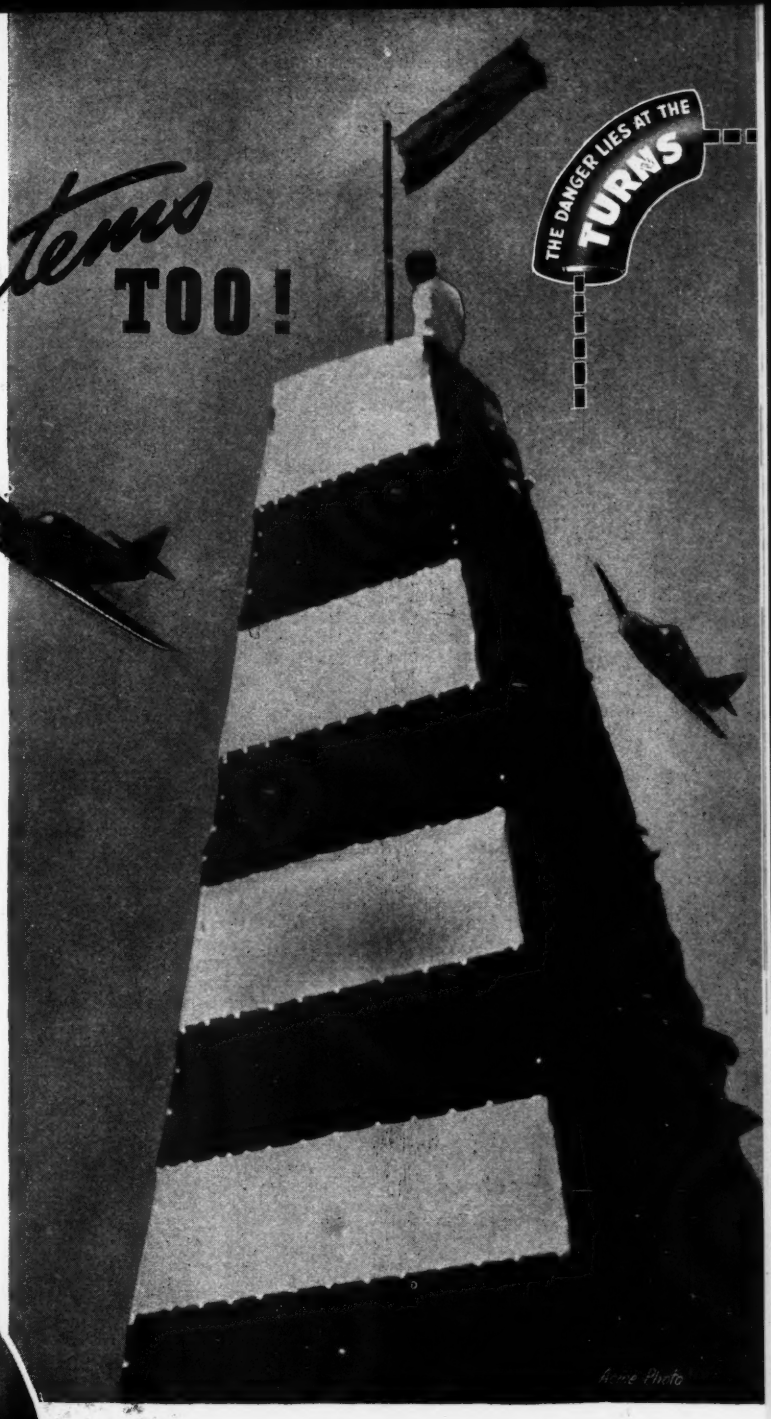
During the period, many organizations will add extra shifts or will make other emergency changes in operation which may render existing guard systems inadequate.

[1]Copies of these can be obtained from the Employers' Association of Chicago, 35 E. Wacker Drive, Chicago, Ill.

WATCH YOUR BADGE
391
SABOTEURS WOULD FIND IT VERY USEFUL
WHEN AWAY FROM WORK
DON'T DISCUSS COMPANY MATTERS
AN UNFRIENDLY EAR MAY BE LISTENING IN!

Two posters submitted by employes of the Union Oil Co. in a Plant Protection Poster Contest

IN PIPING *Systems* TOO!



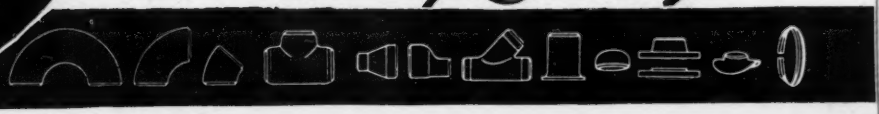
WHEN planes bank sharply and zoom around the pylon-marked turns in air races, everyone holds his breath—for here is where surging power and flashing speed often bring destruction.

In piping systems, it's the *turns* that take the worst punishment—*wherever flow direction is changed.* TUBE-TURN fittings' exclusive construction — plus welding—insures the greatest possible strength, safety and leak-proof performance at these crucial points.

←Pressure, friction, stress and erosion are many times multiplied *wherever there is a change in flow direction.* There are TUBE-TURN fittings for *every* pipe welding need. *Write for catalog and engineering data book with complete technical information.*

TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* NEW YORK, PHILADELPHIA, CHICAGO, PITTSBURGH, CLEVELAND, TULSA, LOS ANGELES. *Distributors everywhere.*

TUBE-TURN
TRADE MARK
Welding Fittings



War News From the Industrial Front

Orderly Production of Turbines Arranged

ORDERLY production of land turbines needed for the generation of electric power for war industries is provided for in an order (M-76) issued March 9 by the WPB. The three major producers of land turbines are Westinghouse, General Electric, and Allis-Chalmers. The effect of the order is to enable the Director of Industry Operations to establish production schedules for orders already placed wtih producers of these turbines and to prevent their displacement by a purchase order subsequently placed.

Such prohibitions do not apply to turbines that might be more urgently nedeed than orders already on the books. In such cases, the Director of Industry Operations may authorize a change which will give a higher standing in the delivery schedule to any turbine more urgently needed.

Have You Any Idle Machine Tools?

OWNERS of idle machine tools were requested March 6 by George C. Brainard, chief of the tools branch, WPB, to make them available for sale so they can be placed in plants engaged in war production. Compliance with this request will help in the WPB's current drive to step up production to meet the goals set by President Roosevelt.

He urged that full information regarding such idle tools be forwarded to the available used tools section of the War Production Board where it can be incorporated in reference files for operators of war-production plants. Mr. Brainard said that a recent recording of tools in the possession of used machine tool dealers resulted in the listing of approximately 40,000 idle machines. Many of these have found their way into war production.

Emergency Power Limitation Order

LIMITATION order L-46 of the WPB provides for curtailment of electric power in Buffalo, Niagara Falls, and Western New York, if and when, power shortages occur. Specifically the order provides for mandatory: Integration of power systems to develop the maximum use of power resources when needed; operation of generating equipment owned by industrial consumers; reduction up to 50 per cent in the power demands of power consumers with demands over 200 kw. who are not engaged in war production or essential civilian services; reduction on a pro rata basis in the power demands of large industrial users at Niagara Falls; restrictions upon the connection of new large industrial consumers with demands exceeding 100 kw. and upon expansion of present loads. Residential consumers are not affected.

OEM Photo

Donald Nelson (insert) chief of WPB ushers in the present production drive by telling the Business Paper Editors that industry must heed the warning "Convert or Perish." He emphasized that WPB can do little more than give clear details of a general plan—that the important part is the initiative of individual industries, large and small. The National Conference of Business Paper Editors, started by Herbert Hoover when Secretary of Commerce, meets regularly in Washington for conferences with important men from the President down through the cabinet officers, department heads, etc. and is probably the best informed group in the country on the present war effort. Since the emergency started, special meetings are frequently called at the request of Washington officials as a prelude to some important new step in war production

Higher Priorities for Utility Repairs

BECAUSE various WPB branches have set up various industrial and repair priority ratings which make the present A-10 utility ratings almost useless, P46, the utility repair and repair priority order is being revised. The revised order which is expected to be issued shortly, will probably carry differential ratings distinguishing between emergency inventories needed for periodic replacement and breakdown supplies.

Low Pressure Boilers Changed

ELIMINATION of metal jackets, fusible plugs, and tricocks from low pressure heating boilers after June 1 was ordered by the WPB March 7 in Schedule III to Limitation Order L-42. The order, however, grants permission to producers to deliver boilers with these fittings provided they were completely finished by that date.

In addition, the regulations required that production of the metal jackets be ended on March 16. No limitation was placed on the manufacture of fusible plugs and tricocks as such because they are used for purposes other than low pressure boilers. Approximately 18,000 t. of steel are expected to be saved by elimination of the metal jackets, and 180,000 lb. of brass by elimination of the tricocks and fusible plugs.

Aluminum Paint Under Allocation

ALUMINUM pigment and aluminum paint were placed under a complete allocation by the Director of Industry Operations, WPB, on March 11. Order M-1-g, requires specific authorization for the manufacture, use, or sale of aluminum pigment and aluminum paint, except in retail distribution to the ultimate consumer. The order took effect immediately.

Auction of Engine Plant Stopped

IN ORDER to prevent the dispersal of valuable machinery adapted to war production uses, the WPB issued an order stopping the scheduled sale at auction of the machinery, tools and equipment in the old Foos Gas Engine Co. plant at Springfield, O.

Purpose of the order was to permit an investigation of the plant and its facilities, to determine whether they could be used intact, and in their present location, for war production. If this is not feasible, the WPB will allocate the machinery and equipment to those engaged on war orders, who are most urgently in need of it.

Keep Ammonia and Freon Cylinders Moving

UNLESS ammonia cylinders are kept in constant circulation, many users of ammonia may have difficulty in obtaining adequate supplies, warned R. J. Quinn, of the Mathieson Alkali Works, Inc. In spite of heavier shipments, ammonia producers can get no new cylinders so the existing supply must serve all users.

If cylinders are kept circulating, however, it is probable that the demands of all essential industries can be met. When

LUNKENHEIMER VALVES

Are Helping to Build Tanks

ESTABLISHED 1862
THE LUNKENHEIMER CO.
"QUALITY"
CINCINNATI, OHIO, U. S. A.
NEW YORK CHICAGO
BOSTON PHILADELPHIA
EXPORT DEPT. 319-322 HUDSON ST., NEW YORK

Your Lunkenheimer distributor has a supply. Ask for your copy.

cylinders are idle, it is usually due to carelessness, which can be easily corrected. Those holding reserve stocks of ammonia should do everything possible to get the cylinders back into service as quickly as possible.

Refrigeration and air-conditioning branch of WPB has also asked all stores, restaurants, factories, theaters, studios, laboratories and film exchanges to ship back all empty freon cylinders to their manufacturers so that they may be refilled and used again.

The cylinders are made out of pressed steel, a critical material, and unless empty cylinders now on hand are returned to the manufacturers by March 10, only two-thirds of the scheduled production of freon gas for March can be packaged. No new cylinders are obtainable and the manufacturers of freon must depend on cylinders already made to pack their entire supply.

Coal Prices Stabilized

ALL COAL dealers, retailers and wholesalers physically handling bituminous, anthracite and lignite without limitation as to size or quantity, were recently asked by the OPA to maintain prices no higher than those prevailing during the period December 15-31, 1941. The only increases permitted are those necessary to cover additional costs of ocean freight, war risk and marine insurance actually incurred for coal transported via tidewater to Atlantic Coast ports.

This request follows one made January 18, directed to retail dealers only, asking maintenance of prices at the December 15-31 levels. In connection with the wider request, OPA set up temporary procedure for consideration of adjustments which may be sought as a result of war conditions.

Since the January 18 request, OPA reports, there has been a general compliance on the part of retail coal dealers but industry conferences with representatives of wholesale and retail dealers and tidewater dock operators indicated the need for clarification and the establishment of procedure for further price studies.

Curb on Oil Burners

NO OIL-BURNING heating equipment will be ordered or purchased for public buildings and other public works being constructed under the general supervision of the FWA in 14 Atlantic States and the District of Columbia. The order, which applies to all the constituent agencies of the FWA, directs that where, in the opinion of the official responsible for construction, existing orders for oil-burning equipment can be cancelled equitably and heating equipment using other fuels can be substituted reasonably, such substitution shall be made.

Simplified Heating

FANCY radiators, concealed piping, and other heating equipment luxuries will probably disappear from trade channels for the duration of the war. At a meeting called by the Plumbing and Heating Branch of WPB to discuss simplification of vapor and vacuum specialties, manufacturers agreed to simplify the number of sizes of radiator valves, trap bodies, and other items in order to save productive capacity and critical materials.

This simplification program will probably include the use of cast iron in a number of parts which formerly consumed brass, and the elimination of several connecting pieces which allowed for concealed radiation. Army and Navy purchasing agents will soon specify the simplified equipment, it was indicated at the meeting. Terms of the requirements will be issued as a separate schedule to Limitation Order L-42.

Compilation of all Priority Orders

A PRINTED compilation of priority orders and forms has been issued by the Div. of Information, Office of Emergency Management, Washington, D. C. It is called Priorities in Force, and is an alphabetical listing of all the orders in the M, L, P, E, miscellaneous orders, that have been issued by the Bureau of Priorities, Division of Industry Operations of the War Production Board, through February 15, 1942. Weekly supplements to the printed compilation, devised to keep the listing up to date will be published in the O. E. M. weekly magazine, Victory. (Supt. of Documents, Washington, D. C., subscription 75c per yr.)

Pipe Fittings Reduced

SIMPLIFICATION of pipe fittings was ordered by the WPB in Schedule II to Limitation Order L-42 covering plumbing and heating equipment. Schedule I, issued earlier, required simplification of iron, brass, and bronze valves. The pipe fittings schedule, in its entirety, has already been issued as a simplified practice recommendation by the Department of Commerce Bureau of Standards under No. R185-42.

Reduction under this program of the number of fittings in current use from more than 8500 to less than 3000 will satisfy 92 to 94 per cent of all demand, according to the plumbing and heating branch of the WPB.

After March 1, grey cast iron, malleable iron, or brass, or bronze pipe fittings not conforming to the established schedule may not be produced, except with express permission. WPB officials said that use of the simplified pipe fittings schedule would release substantial amounts of critical materials which would otherwise be tied up in slow-moving stocks. The schedule eliminates more than 3600 or 73 per cent, of the cast iron fittings formerly produced; over 1100, or about 50 per cent, of the malleable iron fittings; and 784, or about 60 per cent, of the brass or bronze fittings.

Steel Specifications Changed

CHANGES in steel specifications designed to conserve supplies of steel alloys were recently made by the WPB after conferences with representatives of the steel industry and other technical bodies.

Conservation of alloying elements in these new National Emergency specifications is based upon the principle that small quantities of several different alloys are more effective than large quantities of any single element. It appears that these National Emergency Steels and certain others containing less strategic elements, or none, will soon be the only steels available and it is imperative that industry take the necessary steps to change over as quickly as possible so as to be prepared when the supply of habitually-used steels is cut off.

Steels containing the strategic elements nickel, chromium, tungsten, cobalt and vanadium may only be used on extremely important functional parts. Hence, industry is urged to use carbon and intermediate manganese steels (100-1100-1200 series), carbon molybdenum (4000 series), manganese molybdenum (8000-8100-8200-8300-8400-8500 series) or silico manganese (9200 series) wherever possible.

Tables showing analyses of the alternate steels which will be available as well as existing steel specifications with the National Emergency equivalents will be supplied free of charge during the month of April upon application to the Engineering Editor.

Keep Your Car Moving To Last Longer

DRIVE your care every day, at least far enough to warm up the motor, is a rule recommended by Charles M. Hayes, president of the Chicago Motor Club, as one of the most important means of preserving an automobile. Moderate sensible usage is the surest way of making a car last as long as possible and preventing unnecessary repairs.

Daily operation of a car prevents deterioration of tires, battery and engine which set in after the vehicle has been idle even a short time. Club engineers declare that complete disuse results in nearly as rapid wear and distintegration as excessive or abusive driving.

Dollar-a-Year Men Rules On G. A. O. Nos. 4 and 5

GENERAL Administrative Orders No. 4 and No. 5 of the W. P. B. set up new procedures to be followed in appointments on a dollar-a-year basis and for "without compensation" services. Governing procedures for appointmnt to dollar-a-year positions include the following:

Each appointee must be an American citizen of high integrity and good moral character, of outstanding experience and ability, qualified for a responsible administrative, technical, consulting, or advisory position, and in receipt of earned income from his current nongovernmental employment at a rate of at least $5,600 a year.

The position to which the appointment is made must be one requiring special business or technical knowledge and experience.

No dollar-a-year appointee shall make determinations directly affecting the affairs of the firm or company in which he is employed. No permanent appointment shall be made except after a thorough investigation of the proposed appointee by one of the investigatory agencies of the Government.

The procedure relating to appointment of persons on a "without compensation" basis stipulates that such appointees may serve in an advisory capacity as Government consultants working in the public interest and not as representatives of a private employer or industry.

Any person serving on such a basis may not be permitted to assume any administrative responsibility or to exercise any authority over, or direction of the work of, executives or employees of the War Production Board.

For greater protection in feeding boiler water conditioning chemicals % Proportioneers, Inc. % offer the NEW Adjust-O-Feeder —FLUID SEALED against corrosion and plunger build-up.

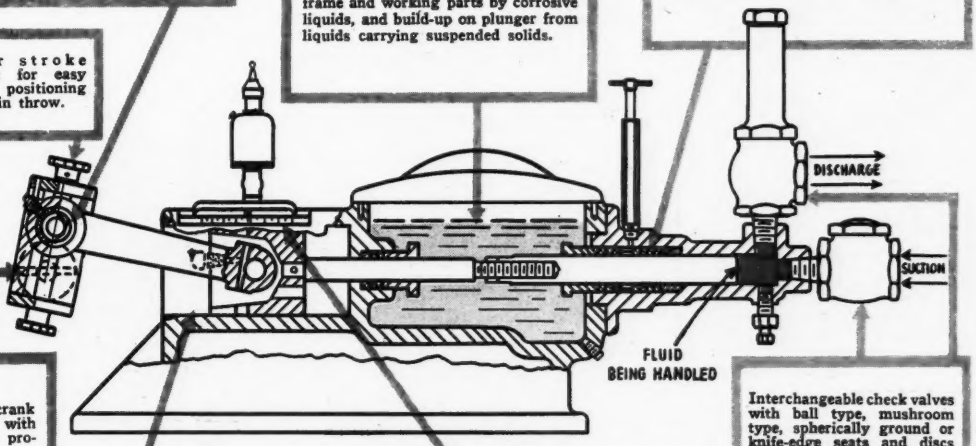
Only ADJUST-O-FEEDER gives you all of these important design features:

Torrington needle bearings with hardened steel races on both crank pin and wrist pin bearings.

Micrometer stroke adjustment for easy and exact positioning of crank pin throw.

FLUID SEALED Plunger and Stuffing Gland prevents destruction of frame and working parts by corrosive liquids, and build-up on plunger from liquids carrying suspended solids.

Extra deep stuffing box with replaceable bushing and provision for addition of packing lubricant while pump is in motion and under pressure.



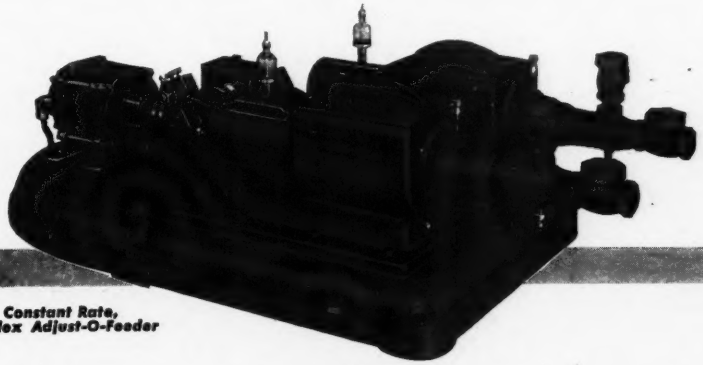
Driving crank equipped with shear pin protection.

Oversize tubular cross-head guide equipped with drip-feed lubrication.

Stroke indicator scale mounted on crosshead frame shows actual plunger displacement at *all* times.

Interchangeable check valves with ball type, mushroom type, spherically ground or knife-edge seats and discs for specific job conditions.

Boiler and Process Water Conditioning Chemicals:
Phosphates, Sulphites, Sulphates, Soda Ash, Caustics, Etc.



Constant Rate, Duplex Adjust-O-Feeder

% *Proportioneers, Inc.* % have a size and type feeder for every high or low pressure chemical feeding job.

% Proportioneers, Inc. % now offer the FLUID SEALED Plunger and Stuffing Gland in all the devices comprising their complete line for Constant Rate and Flow Proportional Treating and Blending Operations.

Write today for recommendations on your boiler water conditioning problems—no obligation.

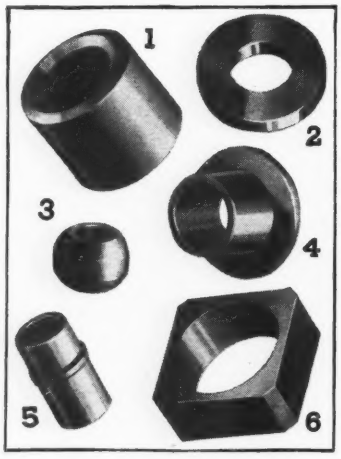
%PROPORTIONEERS, Inc.% 46 CODDING ST., PROVIDENCE, R. I.

New Equipment

Information that you desire about any equipment will be gladly furnished without obligation. WRITE POWER PLANT ENGINEERING.

Self-Lubricating Bearings

THE Keystone Carbon Co., Inc., St. Marys, Pa., announces the addition of Selflube porous iron bearings to their line of self-lubricating bronze bearings. The new porous iron bearings are stronger than porous bronze bearings and



they are interchangeable with porous bronze bearings in most applications. They were introduced to conserve copper and were perfected after years of research work in the company's laboratories.

Selflube porous iron bearings are made from powdered iron, which is moulded to size in the shape desired, then baked, and finally saturated with a good grade of oil. They have an average porosity of 25 to 35 per cent, enabling them to store a large amount of oil which forms a protective, continuous oil film on the bearing surface.

The new bearings have a low friction coefficient which, together with their self-lubricating qualities, prevents excessive temperature, speed reduction, noise and scoring of shaft. The bearings are supplied in both standard and special shapes, as shown in the accompanying illustration.

Electronic Multitester

AN ELECTRONICALLY operated, high sensitivity, multi-purpose meter instrument known as the RCP "Electronic Multitester," Model 662, has been announced by Radio City Products Co., New York, N. Y.

It provides a total of 27 measurement ranges to take care of voltages, both a.c. and d.c., up to 6000 v., resistance to 1000 megohms; capacities to 2000 mf. The low ranges for each of these types of measurement are such that values as low as 0.1 v. d.c., 1.0 v. a.c., 0.2 ohms and 30 mmf. (0.00003 mf.) can be read directly from the meter scale without interpolation or estimating fractional scale divisions. Any one of the 27 ranges is selected by means of two rotary switches, one of which selects the type of measurement desired, the other the numeraical range.

The indicating instrument which is set into the face of the all-metal cabinet, is a 4½-in. square type D'Arsonval microammeter said to be accurate within 2 per cent of full scale. Its direct-reading scales are laid out on a 1000-deg. arc. Protection is provided which avoids the possibility of burn-out or other damage to this instrument through improper range selection or attempting measurement of live resistors, etc.

Its vacuum-tube and power supply circuits are built-in and operating power is drawn from any 105-130 volt line. Applied voltages are held constant by means of a built-in electronic voltage regulator, eliminating the possibility of error resulting from variations in the a.c. supply voltage.

Loading of circuits under measurement is made negligible by input resistance of 160 megohms for the higher ranges and 16 megohms for the lower ranges. Input capacity is 50 mmf. Test leads and all parts employed in the high-voltage circuits are insulated for 15,000 v. Test leads provided, four in

number, include two standard high-voltage leads, one shielded lead with an extension adapter for use in measurements in critical vacuum tube circuits, etc., and a short lead for certain special uses.

The entire instrument is self-contained in a metal cabint 9¼ in. wide, 9¾ in. deep and 7½ in. in overall height. The sloping control panel contributes maximum visibility and operating convenience.

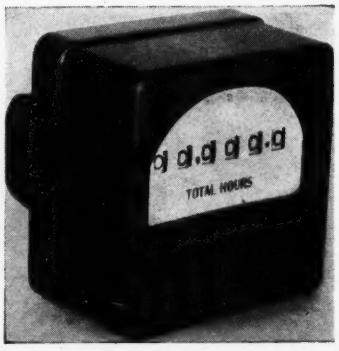
Plastic Cork Coating

NoDRIP, an improved plastic cork coating that stops dripping from condensation or sweating pipes, walls, ceilings, tanks, and the like has been announced by J. W. Mortell Co., Kankakee, Ill. NoDrip has a large field, not only in industry but in the home and on farms, due to its easy and quick method of application by using an ordinary paint brush.

This new coating is spread ¼ in. thick over any metal, concrete, brick, plaster, tile, wood, composition, galvanized or painted surfaces, corners, angles or corrugated ceilings and NoDrip can be painted any color.

Elapsed Time Meter

TO CHECK production and machine tool life in industrial plants where time studies are made, a new meter to indicate elapsed time in minutes or hours is announced by Westinghouse Elec. &

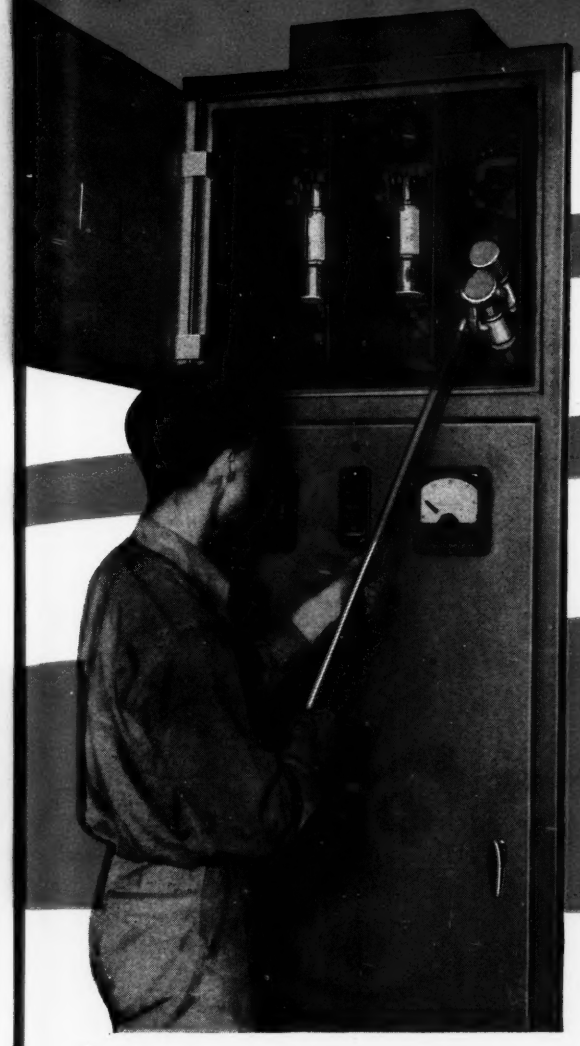


Mfg. Co., E. Pittsburgh, Pa. The meter consists essentially of a synchronous driving motor, a gear train and six numbered wheels. The motor operates at 600 rpm. on a 115 v. 60 cycle circuit. Synchronous operation is not affected by voltage variations of from 75 to 125 per cent of rated value.

To operate, the meter is connected in parallel with the apparatus of which total hours of operation are to be measured. Meter circuits are closed when the machine operates, causing the synchronous motor to run continuously. Resetting to zero or any value is accomplished by removing the case and disengaging the number wheel shaft. The wheels can then be set to any desired reading.

Spectrometer for Gas Analysis

FOR INDUSTRIAL research, refineries, and chemical plants, a mass spectrometer is announced by the Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa. The unit is essentially a high-vacuum tube containing electrodes, filament, slit system, and an electron collector. The gas or vapor to be studied is subjected to bombardment by a narrowly defined beam of electrons in the order of 10^{-6} amp. The pressure of gas in the ionization chamber where the bombardment takes place, is about 10^{-4} m.m. of mercury or lower. The ions thus formed are accelerated through two narrow parallel slits in two parallel plates



Now! COMPLETE PROTECTION IN A 2300-VOLT CONTROL UNIT

- ✓ Short-circuit Protection
- ✓ Accurate Overload Protection
- ✓ Safety for Operating Personnel

LET'S take this new 2300-volt, 60-cycle control unit apart and see what you get. It's really a great team—the EJ 2 current-limiting fuse and our dependable heavy-duty oil-immersed contactor. We have combined them in one metal-enclosed unit to give you complete protection plus long-lived operation.

1ST THE EJ 2 CURRENT-LIMITING FUSE

EJ 2 fuses mean split-cycle short-circuit protection. Current is cut off in less than a quarter cycle and cleared in less than a half cycle — long before the short has had time to harm the starter or motor. Changing these fuses is a simple, speedy operation. Also, they have a disconnect feature, which makes possible complete isolation of individual starters without causing the entire motor line to be shut down.

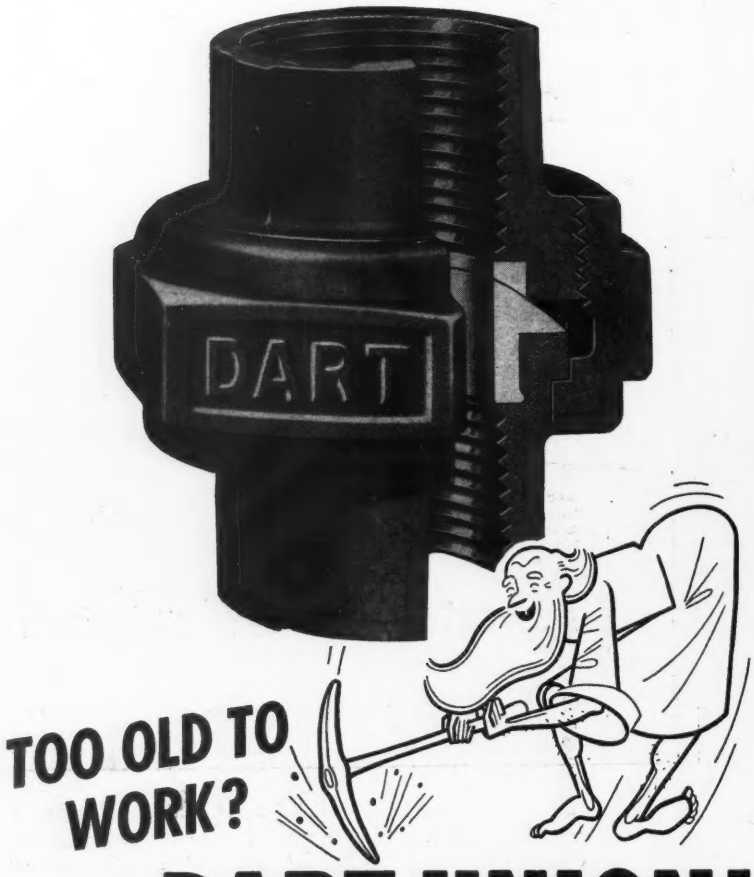
2ND THE OIL-IMMERSED CONTACTOR

This heavy-duty, corrosion-resisting contactor has a record of years of successful service. Extra-heavy, self-cleaning copper tips, wide metal bearings, and extra-flexible, copper-braided shunts combine to give you a contactor that will withstand more than a million operations with only routine maintenance. Isothermic overload relays calibrated accurately against the actual characteristics of your motor protect both it and the starter against damage from sustained overloads.

The current-limiting fuse and the oil-immersed contactor are mounted together in one metal-enclosed unit—a compact, easily installed, completely protected motor control.

You'll want complete information. Our new bulletin tells not only about protection, but also why you can expect long life with low maintenance costs from this new control. Ask the nearest G-E office for GEA-3660. General Electric Company. Schenectady, N. Y.

GENERAL ELECTRIC



TOO OLD TO WORK?

NOT A DART UNION!

PUT YOUR USED DARTS BACK ON THE JOB

A Dart Union can be used again, again, and again with full assurance of getting tight, dependable joints each time. Yes, even a Dart you *thought* was through can be put back to work.

That's why we are suggesting, in the interest of metal conservation, that you make a search of your plant for used or discarded Dart Unions—and put them back on the job.

There are good solid reasons why Dart Unions offer such outstanding performance and reach such a ripe old age. For one thing, Darts have matched bronze inserted seats, precision machined and ground to an accurate true ball joint. Also, Dart bodies and nuts are extra heavy, made of air refined malleable iron that resists corrosion and is proof against pipe strains and wrench abuse.

So—get the *extra* value from your used Darts. Use them again. And see your supplier today to get extra-value new Darts.

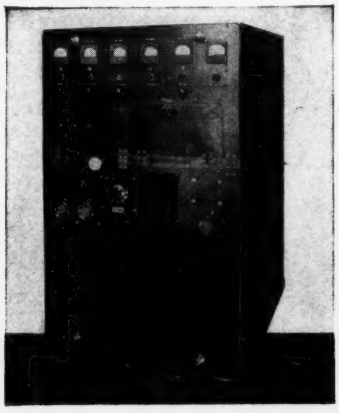
DART UNIONS

E. M. DART MFG. CO. Providence, R. I.

Sales Agents: The Fairbanks Company New York, and all branches
Canadian Factory: Dart Union Company, Ltd., Toronto, Canada

at a potential difference of from 100 to 1000 v. The ions emerge from the second slit as a narrowly defined beam of very nearly the same energy.

This beam is then deflected by a uniform magnetic field designed to sort the ions according to their mass-to-charge ratio. The spectrometer gives directly information about the relative abundance of different kinds of molecular ion fragments formed when molecules of a particular kind are struck by electrons of known energy.

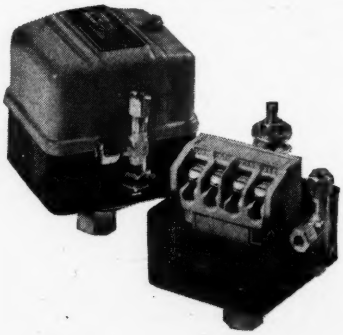


The spectrometer has been used successfully in studying patterns of organic molecules and in determining the purity of gas samples. Sensitivity in the case of air is one part in 100,000. Separation of mass 108 from mass 109 has been made.

Entire assembly is enclosed by steel panels having a black crackle finish except for the control panels which are Micarta. Panels are hinged for accessibility to all parts. The unit is mounted on a rubber-tired truck for complete portability. Only outside connections required are 110 v. a.c. and water connections for cooling the pumps.

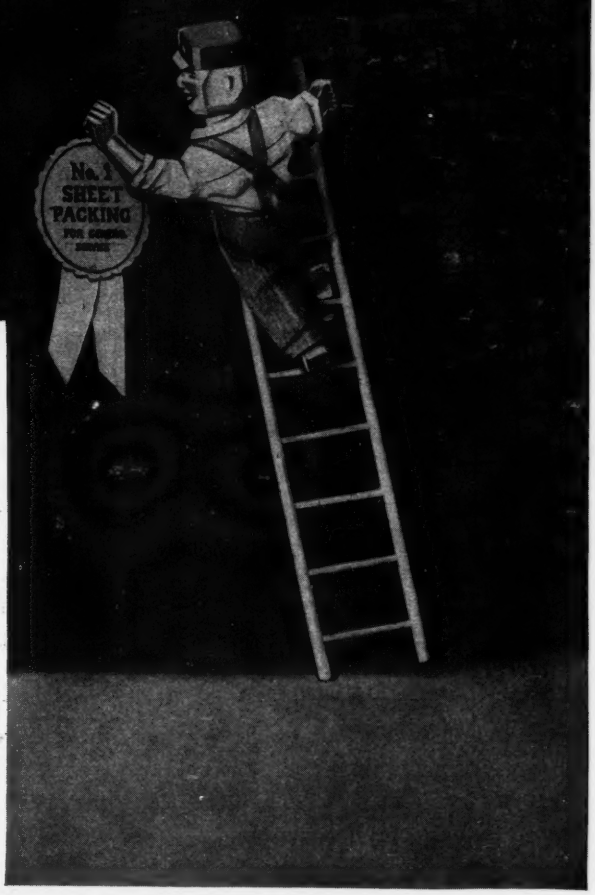
Pressure Switch for Air Compressors

RECENTLY announced by the Square D Co., Detroit, Mich., are two new pressure switches, the 9213A which is the standard and has no valve while the 9213A3 is equipped with a release valve which may be positioned on the switch for convenience of tubing attachments.



The switches are two pole, have a pressure limit of 200 lb. and a 15 to 40 lb. differential. They are especially designed for use with intermediate size air compressor motors. The range and differential can be easily changed in the field to meet varying conditions.

YOU WON'T NEED TO WORRY ABOUT PIPE FLANGES IF YOU SEAL 'EM WITH J-M SERVICE SHEET



Uniformity, dependability, high quality... these are the features that make J-M Service Sheet the No. 1 Sheet Packing for industry

MORE AND MORE engineers are safeguarding gasket performance by switching to J-M Service Sheet. Basically asbestos, this tough material not only stands up longer, but is completely uniform, both in density and quality. Because it does not deteriorate with age, it can be kept in stock indefinitely.

If you're not already using J-M Service Sheet, it will pay you to investigate. And if you have any other packing problems, you'll find an efficient, economical solution in the balance of the complete J-M line. For details, write for the new J-M Packing Catalog, PK-12A. Johns-Manville, 22 East 40th Street, New York, N. Y.

JM

Johns-Manville PACKINGS & GASKETS

THERE'S A DISTRIBUTOR NEAR YOU

THREE INDUSTRIES SUB-CONTRACT PIPING "Headaches"

UPPER LEFT, process piping for oil refinery *CENTER, mine shaft piping*
RIGHT, important links of a steam power installation

THREE different industries – a power plant, an oil refinery and a mining operation – escaped the "headaches" of new piping installation when they *sub-contracted* the prefabrication to Grinnell!

Grinnell engineers are specialists, qualified by long experience to interpret any piping problem. Grinnell plants, strategically located to serve all industries, are equipped with every last facility to prefabricate the most complete sub-assembly and deliver it on the job ready for fast assembly.

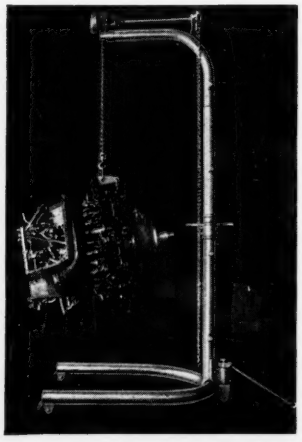
Save yourself a big part of the worries connected with extensions in power or process piping . . . "Give the Plans to Grinnell". That's how leading manufacturers, utilities and process plants are meeting boosted wartime demands. Write for Data Book, "Grinnell Prefabricated Piping". Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

GRINNELL

WHENEVER **PIPING** IS INVOLVED

Aero Hoist

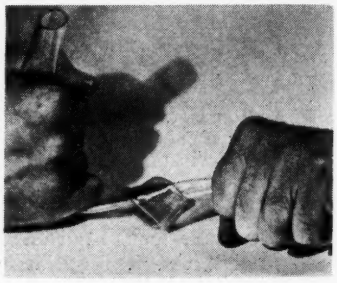
ORIGINALLY designed especially for the aviation industry, the new Aero Hoist, recently announced by the Aviation Department, Whiting Corp., Harvey, Ill., has found a number of applications in industrial plants due to its streamlined design, the elimination of all unnecessary superstructure and its ease of handling.



The Aero Hoist has a single upright mast equipped with riser steps and adjustable platform. A chain hoist raises and lowers the work or supports it at any desired height and an extension keeps the hand chain safely away from the load. A brake locks the hoist in position. It is available in one and two ton models.

Transflex Tubing

A NEW TUBING with excellent resistance to brittleness down to –50 deg. C. has been developed by the Fibron Division of the Irvington Varnish & Insulator Co., Irvington, N. J. Possessing tough and rubber-like qualities, the new



transparent tubing, known as Transflex, is made to secure continued, effective insulation on aircraft flying at high altitudes.

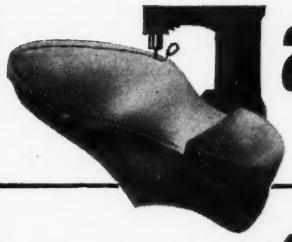
Rotary Control Switch

A NEWLY designed double break, direct acting rotary switch for the control of circuit breakers has been recently announced by Roller-Smith Co., Bethlehem, Pa.

Insulated for 600 v., the switches have a continuous current carrying capacity of 10 amp.

They are furnished with red and green targets to indicate the last position of the switch. If the breaker trips by some means other than by the switch, the green and red targets are seen at the same time.

Give it a New Wearing Surface



APEXIOR

ADDS EXTRA LIFE TO BOILER METAL

No one, in times like these, overlooks any chance to renew the life of valuable possessions — be they shoes or tires.

Prolonged operation of old boilers — even those approaching condemnation — is a proved fact . . . with APEXIOR. If the boiler, when cleaned, can undergo the required hydrostatic test, it can be APEXIORIZED and kept on the line for years.

APEXIOR . . . a Renewable Wearing Surface

APEXIOR No. 1, brush-applied to boiler tubes and drums, adds a long-lasting top-surface to the metal—taking the wear and resisting corrosion. The metal itself is never touched by erosion, corrosion or scale. Scale is prevented from binding—it is easily cleaned off with a wire brush.

The Apexior "skin" is simple to renew. One-coat resurfacing with a hand or rotating brush is all that's needed — every two or three years.

APEXIOR guarantees good metal condition . . . no other protection offers the same assurance and security

Men who demand top efficiency from steam boiler and turbine equipment have used APEXIOR for years—as a supplement to feed-water treatment. In the job of getting peak production from irreplaceable equipment, APEXIOR should be given your full consideration.

ECONOMIZE . . .

APEXIORIZE

APEXIOR
REG U.S. PAT. OFF.

THE DAMPNEY COMPANY OF AMERICA

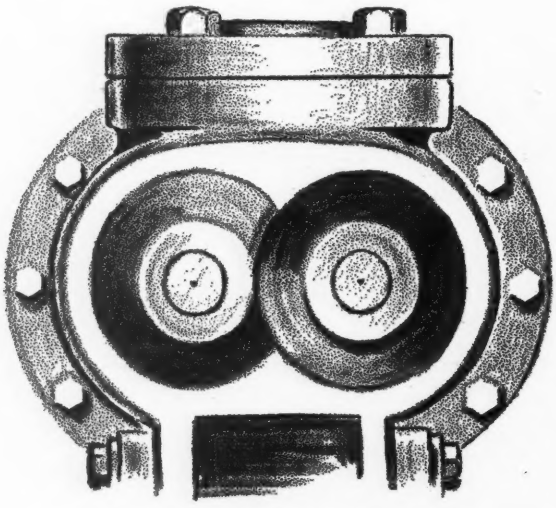
PROTECTIVE COATINGS FOR STATIONARY BOILERS, LOCOMOTIVES AND STEAMSHIPS

HYDE PARK · BOSTON · MASSACHUSETTS

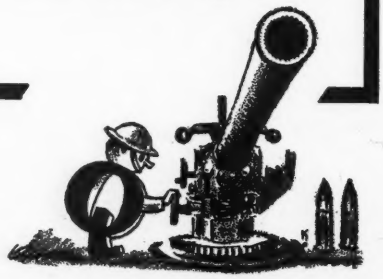
Atlanta Chicago New York Detroit Philadelphia

Engineering Sales Representatives — Pittsburgh, Cincinnati, New Orleans, San Francisco, Los Angeles, Portland, Seattle, Phoenix, Denver, Salt Lake City, Dallas, Houston, Vancouver, B. C., Montreal, P. Q., Havana, Cuba, Manila, P. I., Honolulu, T. H., Marine Dept., 114 Liberty Street, New York, N. Y.

This is the bore



# of an Anti-Axis Weapon.



THE ultimate war of industrial production depends largely upon access to and efficient use of fuel and lubricating oil. That oil must be pumped dependably and economically to create the materials of ultimate victory.

Quimby Screw Pumps are maintaining a steady flow of war-winning oil to the nation's boilers and Diesel engines in factories, utilities and on board ships of the United States Navy and merchant marine. Quimby's commercial performance is equal to critical war requirements both on land and sea.

THE BEST PUMP FOR THE JOB—
IS THE MOST ECONOMICAL PUMP TO USE!

QUIMBY PUMP COMPANY, INC.
352 Thomas Street, Newark, N. J.

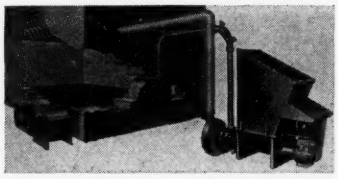
QUIMBY PUMPS

Better Pumping Practice
SINCE 1894

Pneumatic Spreader Stoker

AN IMPROVED series of pneumatic stokers with a separate under-grate fan unit as a distinct feature has been recently introduced by the Iron Fireman Mfg. Co., Portland, Ore.

Fuels as the lower grade bituminous and also sub-bituminous and lignite coals are burned efficiently in these stokers. Coal is conveyed and distributed on a stream of air and hot gases. The fines burn in suspension, utilizing the conveying air for combustion. The larger pieces form a shallow fuel bed on the grate.



Location of stoker can be anywhere within a reasonable distance of the boiler front—either above, below, or on the same floor as the boiler. Coal is automatically fed either from a large capacity hopper or directly from the bunker. The maintenance cost is low, because no moving parts are exposed to fire-zones. Grate design provides ample coaling. Lubrication is positive and efficient, and capacities range from 30 to 1,000 B.h.p.

Remote Valve Control Unit

A NEWLY designed unit for the manual control of remote valves, dampers and other pneumatically operated equipment has been announced recently by the Foxboro Co., Foxboro, Mass. In appearance, the unit harmonizes with the rectangular case in which Foxboro recording and controlling instruments are now

available. When the unit is flush-mounted, its front surface is only $\frac{1}{16}$ in. from the surface of the instrument panel, and as its setting knob and pressure indicator are recessed, there are no protruding parts to suffer accidental bumps.

DON'T LET RUST GET A GRIP ON YOUR TURBINES

TESTED, proved in use by leading utilities and turbine manufacturers, *new* Shell Turbo Oil meets *all three* requirements of modern turbine lubrication...

RUST PREVENTION
SUPERIOR OXIDATION STABILITY
MINIMUM FOAMING TENDENCY

Before you sweeten or drain and change oil, get the details on the *new* Shell Turbo Oil. Call in Shell today!

SHELL

Lubricate with RUST-PREVENTIVE
SHELL TURBO OIL

"MEGGER" INSTRUMENTS IN A WORLD AT WAR

In times of peace our "Megger" Insulation and Ground Resistance Testers are used to protect electrical equipment from failure, to insure continuous service and to safeguard human life.

Now, in a world at war, with machines and men at overload production, these vital protective functions of our "Megger" instruments have multiplied to the point where, at the moment, we are somewhat delayed in meeting the urgent needs of both government and industry.

Thus it is that **"Megger" Testing** in war time ranks equally in importance with the generators, motors and cables that must be tested and retested **that they shall not fail.**

If you are so fortunate as to own a "Megger" Insulation Tester —TAKE TIME TO USE IT. Send immediately for our Pocket Manual of "Megger" Practice and other bulletins which contain valuable information on how to make "Megger" tests, with directions for using all types of the "Megger" instruments. Place this literature and your "Megger" instrument in the hands of your best electrician with instructions to find the weak spots in your electrical system.

If your problem is one of ground resistance measurements, send for our Technical Bulletin on that subject. (No charge or obligation for our literature.)

If you need a "Megger" Tester, either temporarily or permanently, **write, 'phone or wire us.**

JAMES G. BIDDLE CO.

1211-13 Arch Street • Philadelphia, Pa.

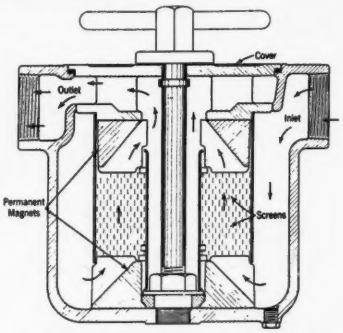
"MEGGER"

TRADE MARK REGISTERED U.S. PAT. OFF

Specifically designed for dead-end service, the unit will hold reduced pressures, dependably, to values within very narrow limits. The unit is also useful in other applications, such as the setting of the control points of distant instruments or the adjustment of positioning or pressure-producing pistons, located in inaccessible points. It is practical for operation over distances as great as 1000 ft.

Magnetic Filter

IN GREATER capacity than any previous permanent magnet FerroFilter of its type, the newest design manufactured by S. G. Frantz Co., Inc., is designated as the PQ-6; capacity 200 g.p.m.; pipe size connection 3 in.; height 15⅝ in.; has no moving parts.

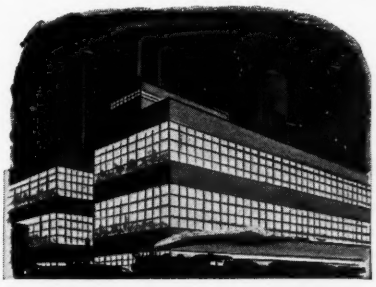


The Model PQ-6 is especially adapted to removal of harmful fine iron and steel particles from circulating coolant systems of machines used in tapping, grinding, deep hole drilling, reaming and rifling and the like, also from circulating lubricating oil systems of pumps, Diesels and blooming mill engines, rod mills, roll grinders or other systems where a continuous, clean supply of lubricating oil is essential.

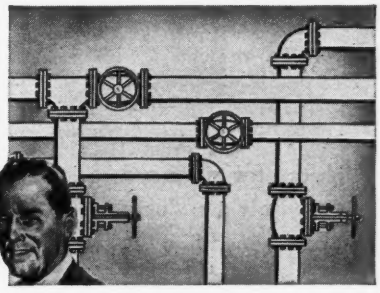
Portable Colorimeter

LUMETRON Mod. 400, a new Photoelectric Colorimeter announced recently by Photovolt Corp., New York City, features portability, simplicity of operation and low price. It is built into a wooden housing with cover and carrying strap, so as to be used in the laboratory as well as in the plant. It works

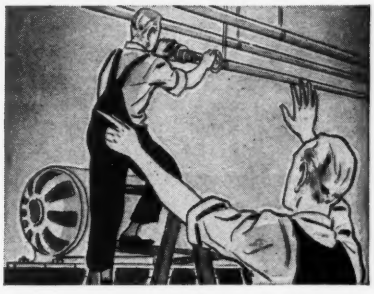
from any a.c. or d.c., 110 v. outlet and is simple in operation. Rugged in construction and always ready for immediate readings, it is designed to meet the requirements of practical colorimetry. The readings are definite and independent of the judgment of the operator, and no standard solutions are required at any time in routine work.



❶ With the plant running 168 hours a week, we needed more and better maintenance—day and night. On piping, for example, you can't get away with part-time maintenance and keep production lines running smoothly. It's too important!

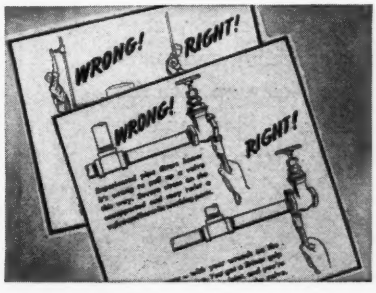


❷ Soon enough, we found valves and fittings would have to be handled with unusual care to get every last bit of service out of them. They're vital equipment, and with all the demands of war, deliveries of replacements were being slowed up.



❸ Sure, we put on more "maintenance" men, but many had never handled a wrench before. We had to start from scratch in training them. In the past, our veteran crews had the time to teach apprentices, but that was "before Pearl Harbor."

❹ You know that piping maintenance is a specialized job. But it's knowing the "kinks" of the trade that makes the difference between good and bad installations. They help speed-up the work as well as step-up efficiency of pipe lines.



❺ We had to teach these men the "rights and wrongs" of piping make-up. We had to be sure they knew enough about valves of all types, and when and where to use them. Good piping depends a lot on using the right equipment.

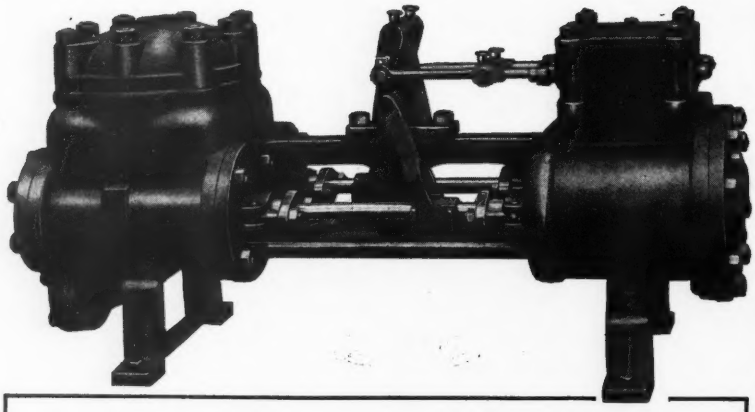
❻ These Crane Shop Bulletins made a tough training job easier. They're full of valuable piping pointers. We used them in employee training classes; posted them in maintenance shops; passed them among the men. Even the old-timers use them! **And listen, any plant can get these Bulletins free—through the local Crane Representative.**

CRANE

CRANE CO., GENERAL OFFICES:
836 SOUTH MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS



WARREN PUMPS
Can Help You to
DO THE "IMPOSSIBLE"

Under today's schedules—which call for *more and more . . faster and faster*—what you are doing today and *will* do later might have seemed like the "impossible" a few years ago. To accomplish your objective, you need men and equipment that can really "give" and "take it" . . . equipment like Warren Pumps.

Warren Pumps are designed and built to give 24-hour service, 7 days a week, year after year—and to do it at consistently low operating and maintenance costs. They are built to "keep up with the mill" . . . that is, to increase their working capacity as the demands of production are stepped up.

If this is the kind of pump performance you are looking for, investigate Warren today.

WARREN PUMPS
Warren Steam Pump Co., Inc.
Warren, Massachusetts

Low-Temperature Fluorescent Lamp

HYGRADE SYLVANIA CORP., Salem, Mass., has recently announced the availability of a new fluorescent lamp specifically designed for low-temperature operation.

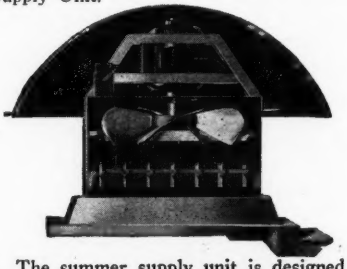
Inasmuch as standard fluorescent lamps do not operate efficiently at temperatures lower than 50 deg. F., these new lamps will fill a very definite, although perhaps limited, need. The lamp is designed to start and operate satisfactorily at temperatures as low as 0 deg. F., when used in conjunction with Hygrade's Mirastat No. 4.

Because of the limited number of applications in which this lamp will be used, it will be supplied in only one wattage and color, as follows: 40 watt T-12 medium Bipin Base 3500 deg. white fluorescent lamp; 1500 hr. estimated life, packed 24 to a standard package. This lamp will carry the marking "LT".

Blackout Ventilators

A NEW ventilation system designed especially for blackout plants and for all buildings erected in the modern wartime blackout type of construction—buildings in which work must be carried on despite the possibility of air raids has been announced by the Trane Co., LaCrosse, Wis.

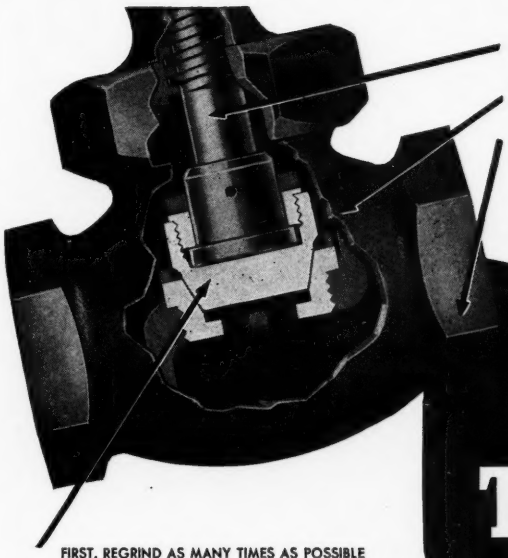
The blackout ventilators provide a change in the conventional practice of ventilation which has been created by the present huge program for industrial building expansion. The ventilators are available in three basic models: Exhaust Unit, Summer Supply Unit and Winter Supply Unit.



The summer supply unit is designed to provide large volumes of outside air with perceptible air motion at all times. It is a means of introducing fresh air for ventilation and for reducing solar heat gains as in the case of large industrial plants or where ventilation for particular industrial processes is needed. The exhaust unit has the same general design as the summer supply unit, and as the name implies, is merely an exhaust fan arrangement whereby the air in occupied areas is exhausted from the building. The winter supply unit is designed for application in conjunction with the existing heating system, and contains heating coils, face and bypass dampers, and a propeller fan. The units include grease-lubricated motors and are designed for easy maintenance.

Luminous Paint

A LUMINOUS blackout paint, which can be applied to objects of all kinds to render them visible in the dark, has been developed by Maas & Waldstein Co., Newark, N. J. Unlike the radioactive finishes commonly used on watch dials, the new paint owes its luminosity to a substance which re-radiates light, according to the manufacturer. It contains no toxic materials. After the paint


STEM OF SPECIAL CORROSION-RESISTING, HIGH STRENGTH ROLLED BRONZE
SUBSTANTIAL WALL THICKNESS OF PRATT & CADY BRONZE VALVES RESIST CORROSION AND EROSION
HEAVY HEX PROVIDES GREAT RIGIDITY

FIRST, REGRIND AS MANY TIMES AS POSSIBLE
THEN REPLACE ONLY THE SEAT AND DISC

...—*Save* ALL THAT BRONZE

READING-PRATT & CADY MADE IT POSSIBLE FOR YOU TO *RENEW* BRONZE VALVES INSTEAD OF REPLACING THEM

It is imperative, when it comes to Bronze and other metals now scarce and strategically important, that we all return to old-time thrift—*use it, mend it, make it do.*

Remember this when your Bronze valves show signs of the wear and tear of 24-hour Victory production because in very few cases do you need to *replace* them.

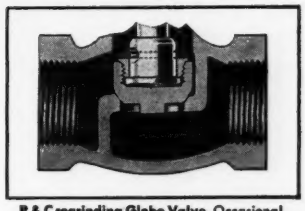
1885—PRATT & CADY INVENT GLOBE VALVE WITH RENEWABLE SEAT AND DISC

By inventing the Globe Valve with renewable seat and disc, Pratt & Cady made it possible for you to *renew* your worn Globe Valves—to use minimum materials and time for the maintenance job.

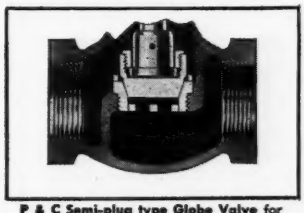
By inventing and patenting the Retaining Ring Gate Valve—diagram at the bottom to the right—Pratt & Cady made it practical to renew the seat of Gate Valves without removing the valve from the line.

So, again, we say save all that *Bronze*. First, regrind disc and seat to an efficient seat as many times as the materials can be worked-over. Then replace only the disc and seat—in that way maintaining your valves at peak efficiency with minimum use of vital materials and precious time. *RENEW* your valves. DON'T REPLACE them.

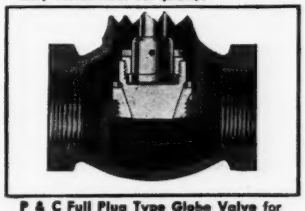
Reading Cast Steel Valves & Fittings • Pratt & Cady Brass & Iron Valves
D'Este Valve and Engineering Specialties



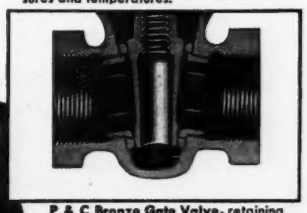
P & C regrinding Globe Valve. Occasional throttling of air, hot water, saturated steam.



P & C Semi-plug type Globe Valve for frequent throttling in services where ordinary valves wear out quickly.



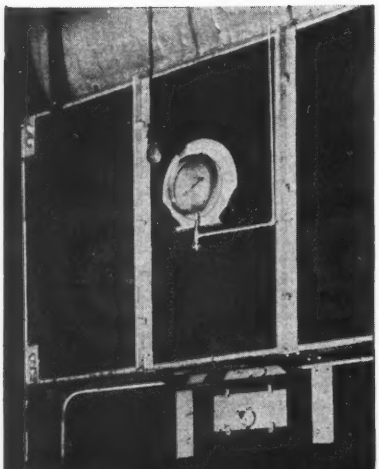
P & C Full Plug Type Globe Valve for severe throttling at maximum rated pressures and temperatures.

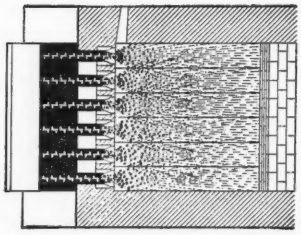


P & C Bronze Gate Valve, retaining ring construction. Perfect seating without machining with seat rings in place.

READING-PRATT & CADY
READING, PENNSYLVANIA

A *Division of* AMERICAN CHAIN & CABLE COMPANY, INC. *Bridgeport, Conn.*





Burns Coal Like Oil!

THE above plan view of a 6-burner FYR-FEEDER shows the uniformity of the coal distribution pattern

A COMBINATION that can't be beat:

COAL + FYR-FEEDER

HERE is timely help for American industrial plants now worried about growing steam demands . . . fuel shortages . . . insufficient firing capacity . . . and dangerously overloaded equipment.

FYR-FEEDER Industrial Spreader Stokers can match or exceed the high heat release rates of any present method of firing and they can do it with practically any type of bituminous coal or lignite.

If you are now engaged in work vital to defense and civilian needs, don't overlook the fact that FYR-FEEDER Industrial Stokers are helping many organizations meet every need for higher capacity . . . simple, automatic operation . . . low investment, low fuel cost. *Ask for FYR-FEEDER facts.*

DELIVERY. Quick delivery of FYR-FEEDER Spreader Stokers is assured for industrial plants working on Defense contracts . . . plants producing essential civilian goods . . . food processing plants . . . institutions and schools . . . mines . . . utility plants . . . railroad steam plants . . . or plants otherwise qualified to obtain priority ratings. For complete details, use the coupon below.

TERRITORIES FOR SALES ENGINEERS
Some territories are open for experienced sales engineers familiar with steam plant boilers and furnaces. Information on request. Please furnish record of your experience and references.

AMERICAN COAL BURNER COMPANY

FOUNDED 1918

Builders of thousands of Industrial stokers

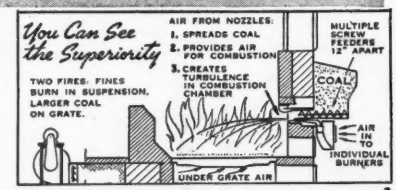
AMERICAN COAL BURNER COMPANY,
ENGINEERS
22-18 East Erie St., Chicago, Ill.

- ☐ **YES, I want to know what the FYR-FEEDER can do in our plant.**
- ☐ **Please mail descriptive literature.**
- ☐ **I am interested in selling FYR-FEEDERS.**

Name .....

Company .....

Address .....


You Can See the Superiority
AIR FROM NOZZLES:
1. SPREADS COAL
2. PROVIDES AIR FOR COMBUSTION
3. CREATES TURBULENCE IN COMBUSTION CHAMBER
MULTIPLE SCREW FEEDERS 12" APART
TWO FIRES: FINES BURN IN SUSPENSION. LARGER COAL ON GRATE.
COAL
AIR IN TO INDIVIDUAL BURNERS
UNDER GRATE AIR

MULTIPLE BURNER SPREADERS ARE A VERY WORTHWHILE ADVANTAGE. Each FYR-FEEDER has 2, or 4, or more burner spreaders giving dependability and convenience in cleaning grates impossible to secure with a single spreader.

has been exposed to either daylight or ordinary electric illumination for a few minutes, it glows for about 20 hr. and repeats the action after re-exposure.

The new Durad Luminous Paint, must be used over a special primer and thinned out with a special thinner, both of which are supplied with the paint. One thick coat, or preferably several thin coats, of the point produces a flat white finish suitable for indoor service. For a glossy finish, or for outdoor service, the paint is covered with a special clear topcoat. Each coat air dries in from 1 to 4 hr. depending upon weather and other conditions.

Water Conditioning

A NEW, completely supervised system of boiler water conditioning known as the Technical Water Conditioning System was recently announced by the Water Treatment Co. of America, Pittsburgh, Pa.

The Technical System combines the advantages of complete supervision and analytical servicing of boiler, feed lines, condensers, etc., plus a simplified natural water correction utilizing individualized Baerite Organic Formulas especially developed from analysis of water samples and boiler or water system conditions.

These specific formulas are individual variations of the standard Baerite Organic Formulas previously marketed by the company. Formula variations developed to exactly fit the needs of each user are assigned a special identifying number, and are only supplied to the original user except where water conditions are exactly duplicated. Regular, scheduled boiler and water inspections and recommendations by company experts are part of the service.

MANUFACTURERS' NEWS

Increased demands for metering and control equipment to speed production in war industries has necessitated an enlargement of the Bailey Meter Co.'s field engineering staff. Engineers who have recently been assigned to field work include J. T. Elder and J. E. Wood, Atlanta; J. E. Luppold, Seattle; E. P. Nye, Buffalo; R. B. Pogue, Milwaukee; W. D. Hilborn, Houston; J. J. Haslam, Kansas City; J. J. Wilber, Cleveland; C. E. Hicks, New York; J. R. Powell, Pittsburgh; S. G. Dukelow, Denver; R. V. Johnson, Chicago; W. D. Robinson, Boston, and C. C. Holtzman, Philadelphia.

Work on a new plant for the production of metallic magnesium and chlorine will begin immediately, according to an announcement made by E. M. Allen, President of the Mathieson Alkali Works, Inc.

The plant, which will be located at Lake Charles, La., and will cost approximately $22,500,000, will be owned by the Defense Plants Corp. It will be operated by Mathieson and is estimated to produce about 36,000,000 lb. of magnesium a year by a specially developed process.

The Bird-Archer Co. announces the appointment of the Tesco Chemical Co., Atlanta, Ga., as their Southeast-

10 REASONS why you can bank on FAIRBANKS

Extra Service Value At No Extra Cost

Fairbanks Valves—with more than half a century's service record and acceptance behind them—are definitely *quality* valves.

In addition to correct design, careful selection of materials and accurate workmanship, Fairbanks offers features which contribute to dependable performance, low upkeep and outstanding endurance. Yet Fairbanks Valves and Fairbanks performance are available at standard prices.

Never was there a time when it was so important to choose valves that you can depend on . . . *quality* valves that will give you long, trouble-free service.

The Fairbanks Distributor in your territory is ready to serve you. Write us for his name if you don't know it. Also ask for Catalog No. 21.

1. Prompt service through conveniently located distributors.
2. Standard and Renewable types for practically every need.
3. Quality in design, materials and workmanship.
4. Uninterrupted service.
5. Low in maintenance cost.
6. Maximum years of service assured.
7. Acclaimed for dependable performance.
8. Nationally accepted by users.
9. Backed by over 50 years' specialized experience.
10. Technical assistance in valve selection.

THE FAIRBANKS COMPANY

399 Lafayette St., New York, N. Y.

Boston, Mass., Pittsburgh, Pa.

Factories: **Binghamton, N. Y., Rome, Ga.**

You can bank on...

FAIRBANKS

as the **RIGHT VALVES TO USE**

In the EVERLASTING
DUPLEX BOILER BLOW-OFF UNIT

1. Tightness

. . . is assured and maintained by the self-grinding seal of the Everlasting Blow-off Valve and the narrow, flexible sealing ring of the Everlasting Companion Angle Valve. In the Everlasting Blow-off Valve, the disc moves across the seat in a *rotating motion* and is in *constant contact* with the seat, thus regrinding the disc against the seat whenever the valve is opened or closed. In the Everlasting Companion Angle Valve, a perfectly fluid-tight seal is provided by the flexible, narrow-face ring which yields to slight irregularities of the sealing surface and the sealing edge as it is compressed between them.

2. Resistance to wear

. . . is provided by the constant spring-maintained contact of disc and sealing surface which prevents grit from getting between the sealing faces of the Everlasting Blow-off Valve disc and seat; and by the design of the Everlasting Companion Angle Valve in which the sealing elements are not subject to destructive erosion from the flow of fluids.

Made in sizes 1½-in., 2-in., and 2½-in. for 250-lb. 300-lb. and 600-lb. Comply with all code requirements.

Write for Bulletin

EVERLASTING VALVE CO., 49 Fisk St., Jersey City, N. J.

Everlasting Valves

for everlasting protection

ern representative. Sales engineers employed by Tesco cover the Carolinas, eastern Tennessee, Georgia, Alabama, and Florida.

Fairbanks-Morse Announces Further Expansion

A DOCUMENT officially annonncing the intention of the United States Navy to spend $15,600,000 for buildings and equipment that will make it possible for the Beloit Works of Fairbanks, Morse & Co. in the next 18 mo. to multiply by six its present output of Diesel engines and auxiliary equipment for the Navy, has been received by the company.

The $15,600,000 allocation reported includes the original facility of approximately $6,000,000 announced several months ago. Shortly afterwards, the Navy required more of the production of Fairbanks, Morse & Co. and the appropriation was increased to $6,800,000.

The new facility means the addition of more than 50,000 sq. ft. of floor space to the 320,000 sq. ft. already provided in the new building now under construction in Beloit. It means also the erection of several auxiliary buildings elsewhere in the plant, including one building of 30,000 sq. ft. which will be used for the storage and warehousing of incoming parts and materials.

MANUFACTURERS' PERSONALS

French E. Dennison, commercial refrigeration development department of the York Ice Machinery Corp., has been called to the Philadelphia Ordnance District by the War Department, to serve as chief inspector. Mr. Dennison served with the Rock Island Arsenal during World War 1, as the first refrigerating engineer in Ordnance, and engineered the general refrigeration, water cooling, and air conditioning systems. For many years he was chief engineer of the General Refrigerating Co., Beltoit, Wis.

Joseph T. Wright was recently appointed manager of the Compressor and Tool Division of Worthington Pump and Machinery Corp., at its Holyoke plant. Mr. Wright served as assistant works manager of Lodge and Shipley Machine Tool Co. during World War 1, and later organized the J. T. Wright Co. of Cincinnati for the manufacture of paper drilling equipment. This organization was subsequently merged with Harris-Seybold-Potter Co., Dayton, with which organization Mr. Wright served in several responsible capacities.

Appointment of H. L. Dinsmore as chief industrial engineer of Elliott Co. has recently been announced. He will supervise the acquisition, arrangement and location of manufacturing facilities, the setting of standards in production planning, and determine manufacturing methods. Mr. Dinsmore, in recent years, has been associated with Coverdale and Colpitts of New York, and previously with Miller, Franklin and Basset and Co.

What the well-dressed welding fitting wears—

You see at a glance
the size and thickness of a

WeldELL

NO guessing . . . no measuring . . . no "miking." No wrong size mistakes among fittings delivered to the job . . . no trips back to the stock room to correct errors. Not if you use WeldELLS, for every one is fully and permanently marked and you see at a glance the size and thickness you're getting.

This is just one of the "convenience features" of WeldELLS that help keep welded piping costs down to an absolute minimum.

But that isn't all, for WeldELLS have other advantages, too. Some save installation time . . . others provide engineering improvements. Combined they give you the extra value that makes WeldELLS the "best buy."

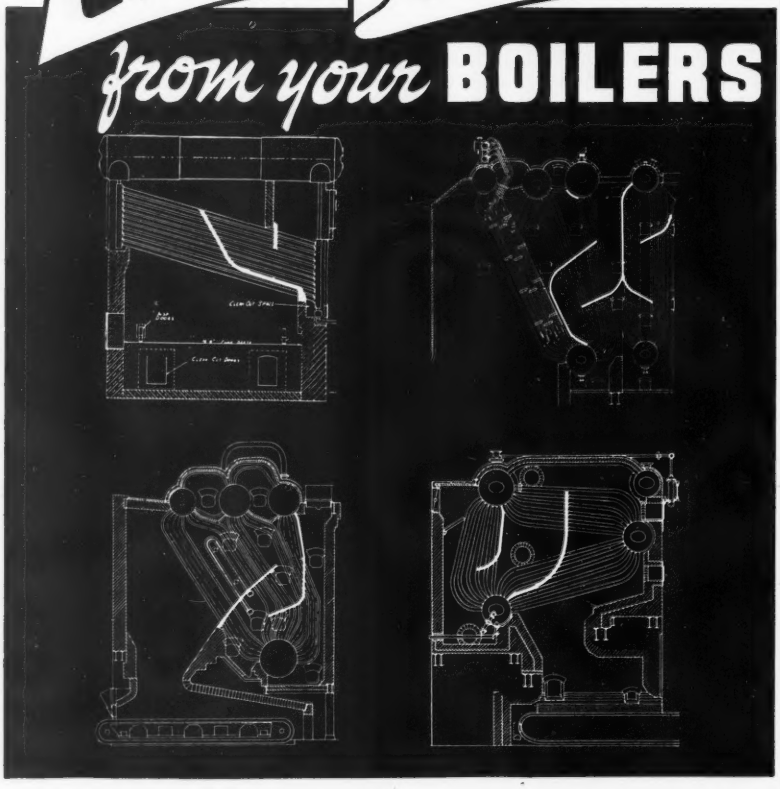
TAYLOR FORGE & PIPE WORKS
General Offices & Works: Chicago, P. O. Box 485
New York Office: 50 Church Street
Philadelphia Office: Broad Street Station Building

WeldELLS have *everything*

No other fittings for pipe welding combine these eight features. Besides permanent markings (described here) the features are:

1. **Seamless**—greater strength and uniformity.
2. **Tangents**—keep weld away from zone of highest stress—simplify lining up.
3. **Precision quarter-marked end**—simplify layout and help insure accuracy.
4. **Selective reinforcement**—provides uniform strength.
5. **Wall Thickness never less than specification minimum**—assures full strength and long life.
6. **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete service and undivided responsibility.

Get that EXTRA POWER from your BOILERS



PRESENT demands on steam generating plants are so heavy that the proper type, location, and construction of baffle walls are of the utmost importance. Enco Streamlined Baffles lower operating and maintenance costs—**but most important** they will increase the output of your boilers.

We would like to tell you more about Enco Streamlined Baffles—why their installation will result in increased capacity and all-around operating efficiency.

Write for Bulletin BW 40 or, for quick action, send blue prints and operating data. There is no obligation.

THE ENGINEER COMPANY
75 WEST STREET • NEW YORK, N. Y.

Enco Streamline Baffles
PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

Ralph Kelly, formerly vice president in charge of sales for the Westinghouse Electric & Mfg. Co., has become associated with the Baldwin Locomotive Works. In his new connection he will be executive vice president.

Francis J. Sill, consulting engineer, and K. R. Warrington, an associate for the past 12 yr. have established the firm of Sill and Warrington at 211 Congress St., Boston, Mass.

D. H. Lauder, local engineer of General Electric's Pittsburgh office for the past 6 yr., has been appointed assistant to W. M. Denny, assistant manager of the company's Contract Service department at Schenectady, as announced recently by F. P. Wilson, manager of the department.

Mr. Lauder, a native of Lonaconing, Md., was graduated from the University of Pittsburgh in 1922 with a B.S. degree in electrical engineering, and later that year entered G-E's Test course at Schenectady as a student engineer. He also did test work at the G-E plant in Pittsfield, Mass. He was formerly a foreman of the company's Pittsburgh outside installation force and also assistant to the local engineer of the G-E office there.

Elmer J. Weis, former aircraft parts manager of the Pacific Pump Works has been made vice president, according to an announcement by Mr. J. B. O'Connor, chairman of the board. Mr. Weis, with the company since 1923, has been responsible for the operation and supervision of the company's aviation hydraulic actuating assemblies division and has also been identified with many engineering improvements in the Pacific Pump Works' line of centrifugal pumps, pipe line and hot oil service; deepwell centrifugal turbines and deep well oil pumps.

Ralph R. Newquist has been named as assistant to Walter Geist, vice president of the Allis-Chalmers Mfg. Co. Mr. Newquist has been the manager of the Company's district office at Houston, Texas. He also has served in the firm's district offices Chicago, Pittsburgh, and Boston. C. W. Schweers succeeds Mr. Newquist as manager of the Houston office.

James S. Anderson is now connected with the New York District Sales Office of The Babcock & Wilcox Tube Co., 85 Liberty St., New York City. Mr. Anderson went to The Babcock & Wilcox Tube Co. from Steel & Tubes Div. of Republic Steel Corp. where he was affiliated with the Cleveland General Sales Office and more recently the Philadelphia District Sales Office. He is a graduate of the Case School of Applied Science, class of 1932.

Sawyer Electrical Mfg. Co., Los Angeles, Cal., announces the appointment of George M. Snodgrass as manager of its Eastern Sales Div. with headquarters at 2110 Terminal Tower, Cleveland, O. A wholly-owned subsidiary of the A. O. Smith Corp., the Sawyer Company manufactures a line of special electric motors for machine tools as well as rotors and stators for built-in applications. Before his recent appointment as Sawyer division manager, Mr. Snodgrass was vice president and sales manager of the Imperial

Shown here is an 8-inch, Class 1500 pound, welding end, cast alloy steel Gate Valve, with welded bonnet, special by-pass, and welded sediment and inspection cap. Valve is powered by Limitorque Motor Operator.

A GOOD NAME

You don't build a good name in a day or a year. It comes from doing a good job for a long time. After that, people begin to expect a good job from you and they bring their business to you for that reason.

We've been at our job a long time. Just four years short of a century. All these years we've been making valves. With each new industrial development in which valve design has played a part we've made new valves or adapted existing models to changing needs. In each instance our efforts have met with the approval of the Industry which was served.

This experience has taught us to expect changes and to be prepared for them. It has led us to build up a well trained engineering and research department fully equipped to handle new valve problems as they arise in the Progressive march of American Industry.

The Powell Line itself is evidence that we have not been idle. The ever-increasing demand for Powell stock valves and Powell engineering service is a constant reminder that the job we have been doing all this time has satisfied our clients, and has given them reason to expect that it will continue to be good. This is, in our conception, the meaning of a good name.

The Wm. Powell Company
Cincinnati, Ohio

POWELL VALVES

War Orders Call for Higher Pressures AND R/M PACKINGS

The war requires more asbestos—and more of asbestos—than history has ever known. Fluids must travel at faster speeds and greater pressures, and packings must control them. Lubricants must fight higher temperatures, and the packings must not fail!

R/M packings are solving these problems in many different industries. R/M research laboratories are steadily invading and conquering unexplored fields. R/M production is regularly setting new records in an effort to meet the unprecedented demand.

The keyed, illustrated and indexed R/M catalog, which specifies for all ordinary applications, is yours for the asking. In it you will find the answers to most of today's industrial packing problems. See your R/M distributor or write for your free copy.

INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
MANHEIM, PA.
BRIDGEPORT, CONN. NORTH CHARLESTON, S. C. PASSAIC, N. J.
Makers of Packings for Every Industrial Use

Electric Co., Akron, Ohio, and prior to that, sales manager of the Electrical Div. of Fairbanks, Morse & Co.

Howard Coonley Appointed Bureau Head

LESSING J. ROSENWALD, chief of the Bureau of Industrial Conservation for the WPB, has announced the appointment of Howard Coonley as chief of the Simplification Branch of the Bureau of Industrial Conservation.

Mr. Coonley will replace Dr. Edwin Ely who has been serving on a loan basis from the National Bureau of Standards. Prior to coming to Washington, Mr. Coonley, a graduate of Harvard University, had been chairman of the board of the Walworth Co., manufacturers of valves and fittings, with headquarters in Chicago. In the last war he served as vice-president of the United States Shipping Board Emergency Fleet Corp. and in 1939 was president of the National Manufacturers Association.

E. H. Brown Elected Vice President

Edwin H. Brown

EDWIN H. BROWN has been elected a vice president of the Allis-Chalmers Mfg. Co., in charge of engineering and development. Before assuming the new post, in which he will correlate all engineering activities and the development of new products, Mr. Brown was manager and chief engineer of the engine and condenser department for 7 yr.

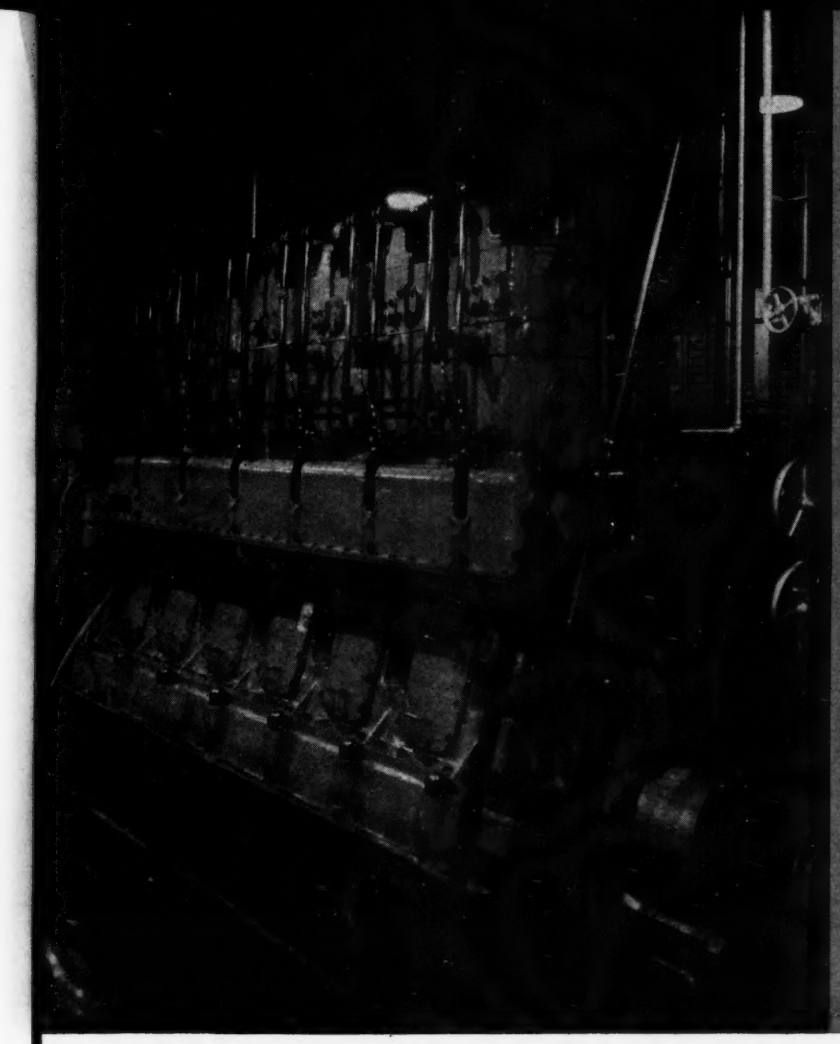
Immediately after obtaining his engineering degree from the University of Nebraska in 1906, Mr. Brown entered the Allis-Chalmer training course for graduate engineers. Upon completion of the 2 yr. engineer apprentice course, he served in various capacities with the company, and then became assistant manager of the steam turbine department. Mr. Brown became head of the engine and condenser section in 1935. The administration of the engine and condenser department has now been taken over by M. L. Carson.

G. E. Announces Promotions

CHARLES E. WILSON, president of the General Electric Co., Schenectady, N. Y., recently announced the advancement of T. F. Barton, New York, and W. B. Clayton, Dallas, Texas, to the positions of commercial vice-presidents. Both men were formerly district managers, and will continue as such.

A native of Orangeburg, S. C., and twice winner of the Charles A. Coffin Award, Mr. Barton has been associated with General Electric Co., since his graduation from Clemson A. and M. College in 1906.

Mr. Clayton, Brooklyn born, and graduated from Alabama Polytechnic Institute in 1905, at the age of 17, joined the General Electric Co. as a student engineer. He has made his headquarters in Dallas, Texas, since the establishment of the Southwest district in 1924.



75,000 Hours

OF TROUBLE-FREE OPERATION WITHOUT REPLACING—

PISTONS · LINERS BEARINGS · VALVES

In operation 24 hours a day, 300 days a year for more than 10 years, two De La Vergne diesel engines in key plants of the Long Island Ice Corp. have operated more than 75,000 hours without a single forced shutdown.

Original pistons, cylinder liners, bearings, and inlet and exhaust valves are still in service. The entire cost of maintenance for the 10 year period for the Huntington, L. I., plant has been $164.01, that for the Smithtown, L. I., plant $173.32. A total for maintenance for the two De La Vergne 320-hp. diesels of $337.33. Only 5 cents per horsepower per year.

The two primary objectives in setting up these Long Island Ice Corp. plants were lowest possible operating costs and maximum dependability. Both requirements have been successfully met. Careful planning, sound plant layout, the best in diesels and a thorough inspection and service system have produced two outstanding cases of diesel engine economy and durability.

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NEWS FROM THE FIELD

Midwest Power Conference

ANNOUNCEMENT has been made of the Midwest Power Conference which is to be held on April 9-10, 1942 at the Palmer House, Chicago, Ill.

The conference is sponsored by the Illinois Institute of Technology with the cooperation of nine midwestern colleges and universities and the local sections of the Founder and other engineering societies.

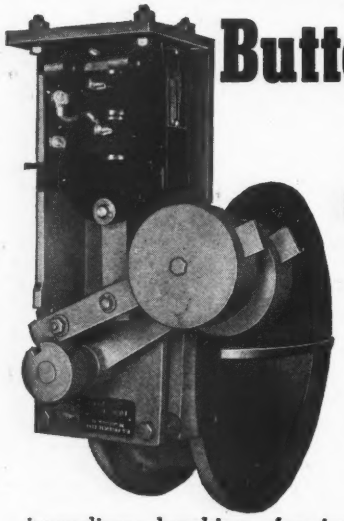
Nine sessions including topics on Central Station Practice, Electric Power Transmission, Industrial Power Plants and Hydro Power will dominate the two-day meeting which will be opened by Chairman M. P. Cleghorn, representative from Iowa State College. Two joint luncheons, one with the Chicago section of the A. S. M. E. and the other with the Chicago section of the A. I. E. E. will be held in addition to the sessions. A feature of the meeting will be the All-Engineers' Dinner on the evening of April 9.

Papers to be presented include: Power and the War Effort, Leland Olds; Prevention of Steam Losses and Fuel Waste in the Present Emergency, V. G. Leach; C-E Controlled Forced-Circulation Boiler, at Somerset Station of Montaup Electric Co., F. H. Rosencrants; Maximum Outputs from Existing Power Plants, E. G. Bailey; Power in the Flour Milling Industry, A. R. Ulstrom; Feedwater Treatment in Small Power Plants, Everett P. Partridge; Power Recovery Installation as Developed by Buick Motor Division, General Motors Corp., Melrose Park, Ill., C. A. Chayne; Silting of Water Power Reservoir, E. W. Lane; and Engineering Features of the St. Lawrence River Project.

The two sessions of the Electric Power Transmission discussion will include the following papers: (Session 1) under the chairmanship of E. W. Kimbark, Recent Field Experience with Natural Lightning and Lightning Proof Line Design by Chas. F. Wagner and A. C. Monteith respectively, both men are from Westinghouse Electric & Mfg. Co. (Session 2) Recent Developments in the Prevention of Outages on Transmission Systems, which will include Ground Fault Neutralizers, Protector Tubes, High Speed Reclosing and High Speed Relaying. Among the speakers discussing these topics will be J. R. North, W. A. Lewis, J. E. Hobson and Hugh E. Keeler, who is chairman.

R-S Solenoid Operated Butterfly Valve

for "Blitzkrieg" Emergency Service



Provides either automatic opening or wedge-tight shut off service when the electric power fails or is turned off due to any emergency. For emergency shut-off service, the butterfly vane is held open by the magnetic action of the solenoid. When the power is shut off the trigger is tripped and the counter weight closes the vane by gravity, wedge-tight against the body of the valve. In case of fire due to incendiary bombing, for instance, the valve in a gas or chemical line would be set for automaitc closing.

Where conditions warrant automatic opening service, the vane is normally set in a closed position. The valve then opens automatically in case of emergency.

The valve itself can be constructed of any metal for air, gas, steam, oil, hydraulic and other services. Sizes 2" to 84" and pressures to 300 lbs.

The vanes of R-S Butterfly Valves seat at an angle and with wedge-tight precision. Because of the non-complicated construction and ease of control, they are ideal for either volume and pressure control or shut-off service. Manual or automatic control. Write for Catalog No. 10-B.

125 lb. Cast Iron American Standard. Hand Wheel Control. Ball Bearing Mounted with Stuffing Box.

R-S PRODUCTS CORPORATION

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E. E. I. Convention Cancelled

DUE TO heavy demands the war is imposing upon electric utility companies, the regular annual convention of the Edison Electric Institute will not be held this year, C. W. Kellogg, President of the Institute announced today following a meeting of the Board of Trustees. The annual convention had been scheduled for the first week in June at Atlantic City.

Electric Energy Produced in December

ELECTRIC ENERGY produced for public use in December 1941 totaled 15,353,703,000 kw-hr., an increase of 16.5 per cent over production in December 1940, according to the Federal Power Commission. Average daily production of electric energy for public use in December was 533,115,000 kw.-hr., an increase of 2.3 per cent over average daily production during the previous month. Production by water power in December amounted to 4,477,827,000 kw.-hr., or 29.2 per cent of the total output for public use.

For the 12 months ended December 31, 1941, total production for public use was 164,946,000,000 kw-hr., an increase of 15.9 per cent over the 12 months ended December 31, 1940. Net imports from Canada totaled 87,303,000 kw-hr. and net exports to Mexico totaled 1,961,000, leaving a net balance of 85,342,000 kw-hr. imported into the United States. The movement of electric energy across state lines totaled 3,032,486,000 kw-hr., or 19.8 per cent of the total generated for public use.

Capacity of generating plants in service in the U. S. on December 31, 1941, totaled 44,024,219 kw-hr., a net increase of 236,182 over generating capacity reported in service on November 30, 1941. However, occasionally changes are made in plants which are not reported promptly, so that capacity figures shown for any one month do not necessarily mean that all the changes were made during that month but that they have been reported to the Commission since the issuance of the previous monthly report.

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4-BA-2

The National Association of Fan Manufacturers at their 25th annual meeting held recently in Detroit elected the following officers for 1942: J. M. Birkenstock, president; Edgar F. Wendt, vice-president, and L. O. Monroe, secretary-treasurer.

Two New Plants for Ohio

WORK will soon be started on two new power plants on the Ohio side of the Ohio River. One of these will be built by the Ohio Power Co., a subsidiary of the American Gas & Elec. Co. of New York. The other will be built by the Ohio River Power Co., chartered in February as a subsidiary of the Ohio Public Service Co. of Cleveland in turn a unit of Cities Service Co. of New York.

The Ohio Power Co. project will be situated about 2 mi. from Brilliant, O. and a contract has already been awarded for structural steel framing, totaling about 2000 t. Work will include complete river facilities for handling coal from river barges with other waterfront structures to include a crusher tower with hoist, water intake, flume for condenser water, and miscellaneous work, with dredging of a harbor and construction of river bank ice breakers. The capacity of the station has not as yet been announced but awards for turbine-generators, high-pressure boilers and auxiliary equipment are scheduled to be made soon.

The Ohio River Power, Inc. plant will be at Dilles Bottom, near Ballaire. The station will be equipped for an initial capacity of 50,000 to 60,000-kw., and is estimated to cost approximately $8,000,000. A new transmission line will be constructed from the plant to the substation at Alliance, O. It is understood that newly organized company is solely for purpose of constructing the station, which will be operated under lease by the parent organization. The Ohio State Public Utilities Commission has granted permission to the company to issue $500,000 stock in amount of $500,000, to be sold to the Ohio Public Service Co.

$10,000,000 Union Electric Expansion

The Union Electric Co. of Missouri, St. Louis, has arranged for an additional bond issue of $10,000,000, to be used for financing expansion in plants and system. The major part of the fund will be used by company subsidiary, Union Electric Co. of Illinois, in connection with work on Venice No. 2 station at Venice, Ill. This plant will represent a total ultimate investment of about $33,000,000. The first section of the station consists of two 40,000-kw. generating units, one of which recently was placed in service, to be followed by operation of the second unit at early date.

A second section of the plant, now in course of cnstruction, will have a similar rating of 80,000-kw., as well as a third section to be completed before the close of 1943.

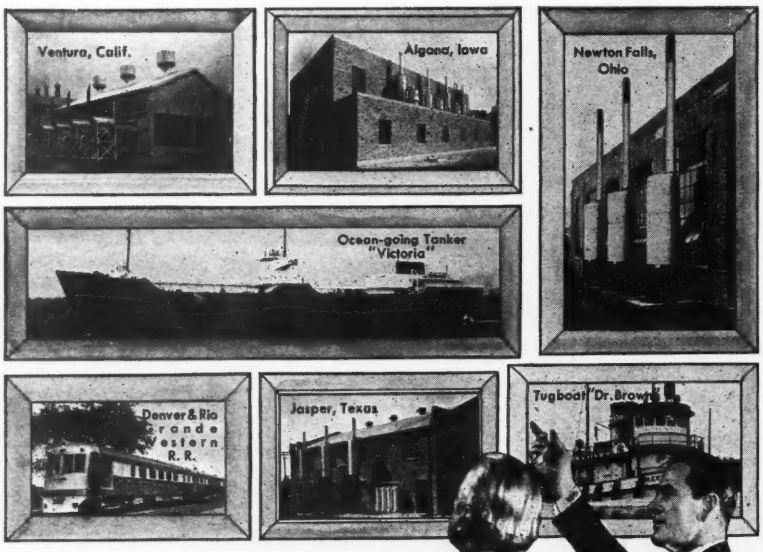
Natural Gas for Wisconsin Cities

NATURAL GAS PIPELINE CO. of America, Chicago, Ill., has asked the F. P. C. for a certificate of convenience and necessity to construct additions to its existing pipeline system to the cities of Milwaukee, Madison, Burlington, Racine, Waukesha, Sheboygan, Manitowoc, Two Rivers, Green Bay, Appleton, Fond du Lac, Oshkosh, Beloit, Janesville, and other cities and towns in southern and eastern Wisconsin.

The proposal is to serve the eastern Wisconsin cities by extending an existing 20-in. main pipeline from its present terminus on the Illinois-Wisconsin boundary approximately 13 mi. south of Burlington northward to Green Bay. Madison, Janesville and Beloit are proposed to be served by building an extension from the main pipeline northward to Beloit and Janesville, and thence to Madison.

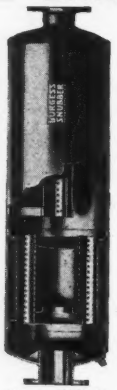
According to the application, the company now has on hand sufficient material to construct about 22 mi. of the mainline from the Illinois-Wisconsin line to a point immediately west of Milwaukee; has already acquired and now owns the right-of-way for the 22-mi. portion; and has also purchased and now owns right-of-way from the 20-in. main line north to Beloit and to a point east of Janesville, together with part of the right-of-way from Janesville to Madison.

No natural gas is now being served in eastern and southern Wisconsin, and none of the utilities serving cities in these areas has access to a supply of natural gas. In further support of the proposals, the applicant states that the introduction of natural gas in the areas will greatly expedite the production of defense equipment and materials by Wisconsin industries, "and the national emer-



Wherever you look
these Snubbers are providing
QUIET DIESEL EXHAUSTS

Diesel engines are now running in all types of plants without objectionable exhaust noise. Hundreds of installations, like those pictured above, are operating in critical locations without exhaust noise complaints. Why? Because these Diesel engines are quieted with Burgess Exhaust Snubbers . . . and there is no interference with efficient engine operation.



Burgess SDHC Series Snubber.

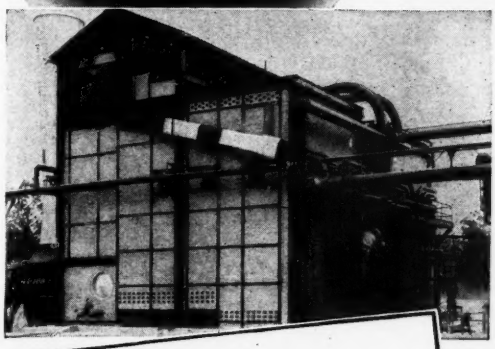
The Burgess snubbing principle removes the source of exhaust noise before the noise can occur. That is why a Burgess Snubber is different in design and performance from ordinary mufflers. For further information about this new method of quieting Diesel exhausts, write Acoustic Division, Burgess Battery Company, 2823-K W. Roscoe St., Chicago, Ill.

BURGESS SNUBBERS

VOGT STEAM GENERATORS

selected for

LAKE CHARLES REFINERY, CONTINENTAL OIL COMPANY

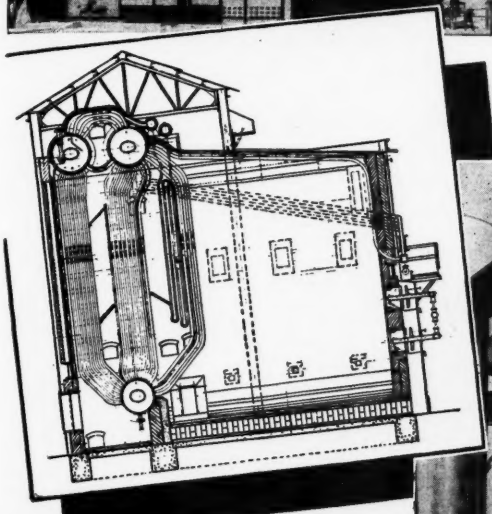


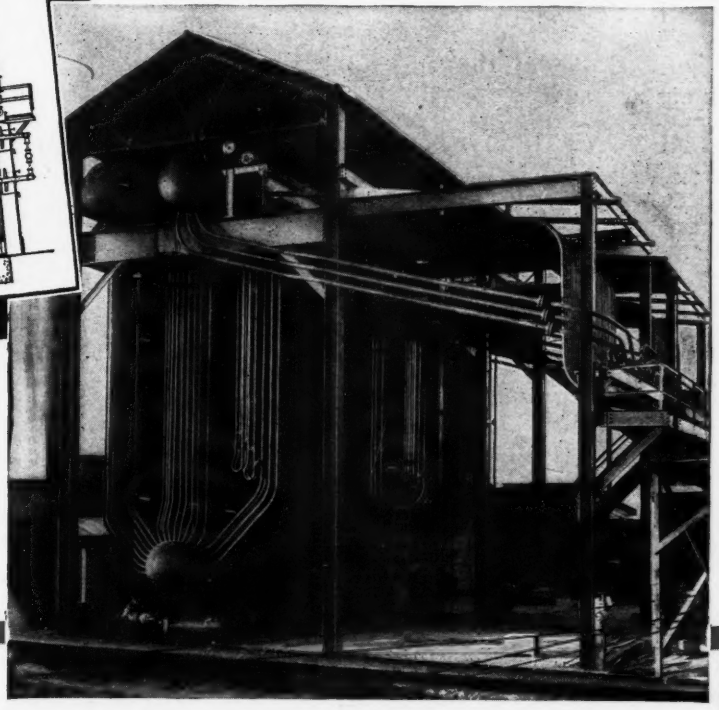
Each of the two units comprising this installation is designed to deliver 95,000 pounds of steam per hour with 165 degrees of superheat, using feed water at 212 degrees F.

Steam and water drums are fusion welded and designed for 400 pounds working pressure.

Furnace walls and floors are air cooled and the furnace roofs water cooled. Burners installed in each furnace are arranged to burn Natural Gas or Refinery Gas Fuel.

These units are provided with a roof only and are operated out in the open like oil stills.





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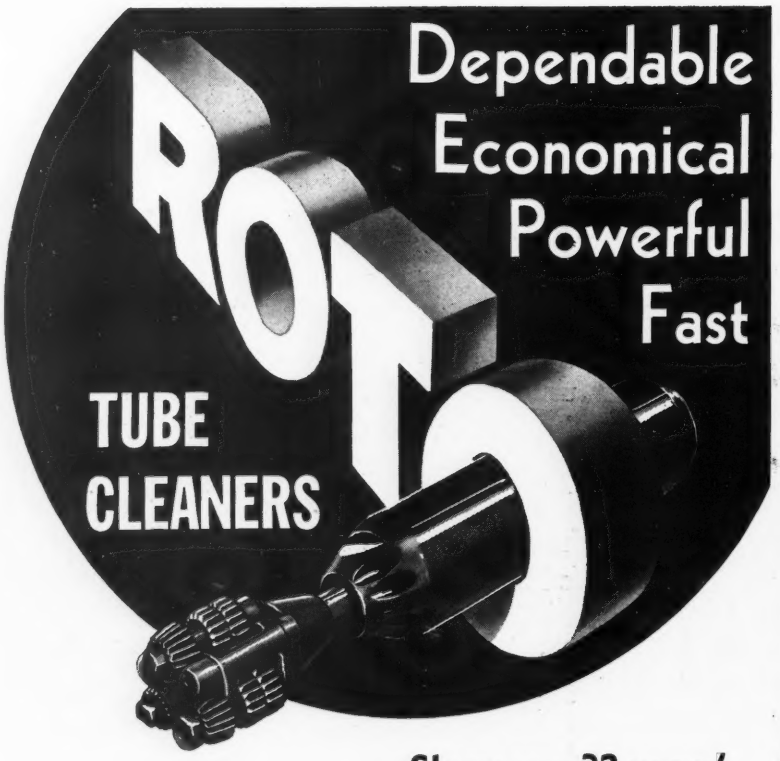

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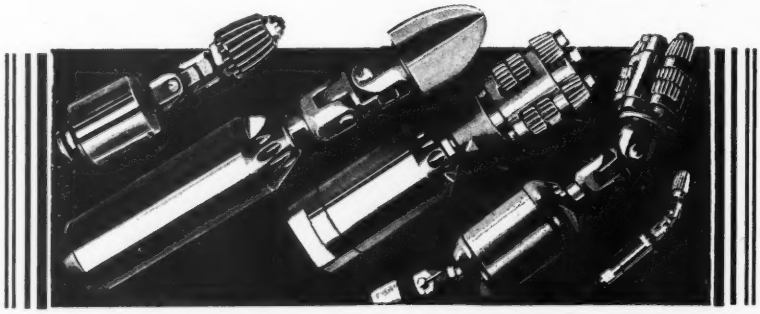


Looking Ahead . . .

In the power field, perhaps more than in other basic industrial fields, the continuous betterments in machinery and methods compel men to look ahead with broader vision and greater determination than ever before.

Reading the advertising messages that appear in POWER PLANT ENGINEERING will keep you informed on new trends and opportunities. Month after month, these advertisements describe what's new in generating, transmitting power. They will help you and your plant join the onward march of the power plant industry.

gency requires that natural gas be introduced into said great industrial area with the least possible delay." Natural gas to be marketed from the proposed lines would be supplied from the Texoma Natural Gas Co., in the Panhandle gas field in Texas and from the Colorado-Interstate Gas Co.

All Wood Pulp to Be Controlled

SEEKING to conserve supplies and direct the distribution of wood pulp, which has an important part in the war program, the War Production Board, March 13, placed the entire wood pulp industry under an allocation system, effective May 1.

Under the system no deliveries of wood pulp may be made except by specific authority of the Director of Industry Operations. Pulp imported and reaching this country after noon, EWT, on May 1, will be held until released by the Director.

In view of the fact that price action on wood pulp is being considered, OPA Administrator Henderson suggested March 9 that pulp producers, in entering into contracts for the second quarter of 1942, may prefer to refrain from inserting prices in their contracts at this time. The OPA is not yet prepared to release maximum prices.

Industrial Accidents Increase

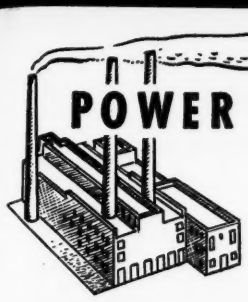
INDUSTRIAL ACCIDENTS in 1941 advanced between 10 and 15 per cent over the previous year, hence the necessity of taking adequate preventive steps to conserve the manpower needed for production.

These, according to the American Optical Co. include a survey of industrial plants to locate those hazardous jobs which require eye-protection equipment, respirators, or safey garments; a definite program to prevent accidents and a plan to enlist the cooperation of foremen and workers; detailed checkups of the entire safety program to insure best results; and posters, constructive messages on eye protection, and other literature that will keep everyone, from unskilled labor to plant executives, mindful of the safety work.

War Industries Interconnection

AN APPLICATION by the New Bedford Gas & Edison Light Co., Cambridge, Mass., to the F. P. C., seeks approval to construct a permanent interconnection of at least 25,000 kv-a. capacity with the Montaup Electric Co. near Somerset, Mass., to assure an adequate and continuous supply of electric energy for defense industries.

This proposed tie is the result of suggestions made by the F. P. C., and, has already been discussed with representatives of the Department of Public Utilities of the Commonwealth of Massachusetts and the Commission. The connection would consist of approximately 20 mi. of 110 kv. transmission line, including a river crossing over the Taunton River, switching equipment, and a transformer at the Acushnet substation of the New Bedford company, at a total estimated cost of $1,093,300.00. Corresponding estimated annual operating costs run approximately 12 per cent of the capital cost, or about $131,200.00.



POWER PLANTS ON LAND AND SEA ARE *Vital to Victory*

In the many thousands of plants engaged in the manufacture of armaments or war materials, boilers are essential to Production for Victory. They need Republic ELECTRUNITE Tubes. *They're getting them.*

Many of the ships of our Navy also depend upon steam for operation. They must have boiler tubes. And they, too, are getting ELECTRUNITE Tubes —which are included in U. S. Navy specifications.

So — if you experience difficulty in obtaining Republic ELECTRUNITE Boiler Tubes promptly from your distributor, remember that we're pushing our facilities to the limit to supply tubes for our power plants on land and sea.

Keep in touch with your ELECTRUNITE Distributor. He and we want to help you in every way possible—to provide the electric resistance welded boiler tubes that mean long, trouble-free service for your boilers.

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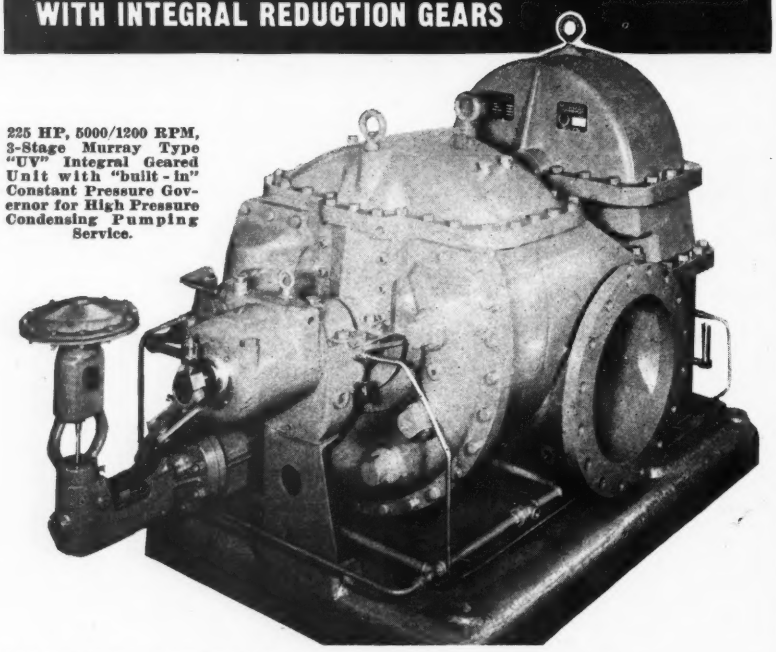
MURRAY TYPE "UV" MULTI-STAGE TURBINES
WITH INTEGRAL REDUCTION GEARS



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New Tool Steel for Axis

FROM the U. S. Bureau of Mines Mineral Trade Notes comes the information that Germany claims certain local steels, when strengthened by admixture with ores, from recently occupied territories, offer a satisfactory substitute for tool steels which need such important metals as nickel, chrome, manganese and tungsten. These newly developed steels are said to be good enough to retain their importance even after Europe resumes trade relations with overseas countries.

Additional Generators for Grand Coulee

THREE generators, each of 108,000 kw. capacity have been ordered for installation in the Grand Coulee Dam power plant which, when completed, will be the largest hydroelectric plant in the world.

Westinghouse Electric & Mfg. Co. was awarded the contract for furnishing and installing these three generators on its bid of $2,792,330. These generators are for units L-7, 8 and 9, which when installed probably in 1944 or 1945, will complete installations in the west power plant and bring the Grand Coulee power development of 1,944,000 kw. to the halfway stage.

Grand Coulee Dam's first generator went on the line October 4, 1941, and was followed by a second in February. Another is scheduled for operation in April of this year. Three more are in varying stages of manufacture and installation.

At the Annual Meeting of The Industrial Unit Heater Association in Detroit on March 4, 1942, election of new officers resulted in E. W. Petersen, president; A. B. Donkersley, vice-president; and L. O. Monroe, secretary-treasurer for the ensuing year. The Association has been co-operating with the War Production Board to standardize on the number of sizes of unit heaters to be offered to the public and the substitution of materials to help conserve copper for the war effort.

First Delivery from Pipe Line

GREENSBORO, N. C., this northern terminus of the newest and biggest, though not the longest, gasoline pipe line in the country, is carried underground nearly 800 mi. from the entry point at Baton Rouge, La. On the night of January 22, less than 7 mo. after the line was started, the Meridian, Miss. terminal received more than 400,000 gal. of gasoline in the first delivery from the line.

This line supplies rapid, unsinkable transportation of gasoline and other refined petroleum products to six southeastern states which formerly got most of their petroleum products by tank ship. Dozens of army posts, airfields, and new defense industries dot the territory. At its maximum capacity, the line will do the work of about 10 tank ships in the same service.

Some of the fastest records ever made were set in the construction of the line. Gangs began clearing ground along the right-of-way on July 28, 1941. On August 14 the first pipe was laid down, and on August 19 the welding crews began work. Between August 20 and December 7 the construction gangs, which at one time numbered as high as 3200 men, laid and welded 800 mi. of

JOHN CRANE WRITES "Last Line" ON CONDENSER packings...

. . . "most modern! easiest, quickest to install! leak-proof under Naval, Marine and Stationary peak-load demands!"

NO FERRULES! (For new and old condensers)

. . . . . TUBE-END DESTRUCTION

. . . leakage, disappearing vacuum, lay-ups and costly retubing —is the heavy price exacted by unscientific condenser packings. Today, corset-lace, grommets, fibre and ferrules yield to precision engineering—to the John Crane method of sealing tube-ends with metallic condenser-tube packing.

10,000 INSTALLATIONS throughout the world are the final testimony; it should convert every engineer to John Crane

. . . . The John Crane method bonds the tube to the tube-sheet with endless metallic and fibre-expansion rings, ELIMINATING FERRULES! Permits free expansion and contraction of outlet tube-ends and easing of stress on plates; prevents creeping at inlet ends; eliminates electrolytic action; increases efficiency in heat transfer equipment; outlasts tubes. John Crane Condenser Packings end erosion, tube-spinning, metal fatigue, grommet-necking, dezincification, decomposition of cord and linen packings—ends the repacking of both old and new condensers . . s(Note: also adaptable to systems using ferrules; installed twice as fast as corset-lace).

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. . . Hundreds of condensers on vessels of the United States Navy and Coast Guard, the British and other leading navies, on merchantmen and in industrial plants—are "John Crane-Packed" and are performing flawlessly under "engagement" peak-load demands . . . Specifying "John Crane" in the past was foresight which now is paying out priceless values in uninterrupted service. Today, the selection of "John Crane" is practically a "must!"

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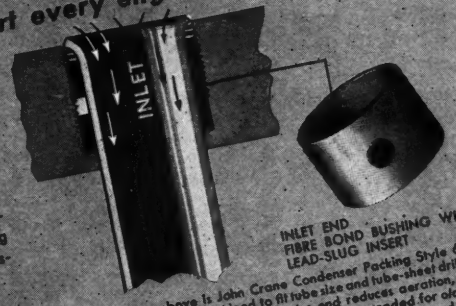
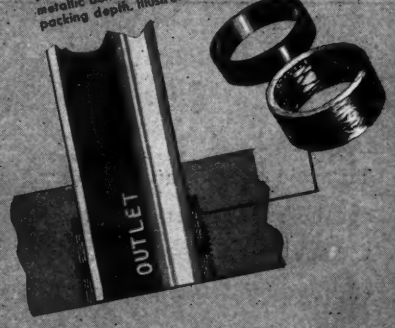


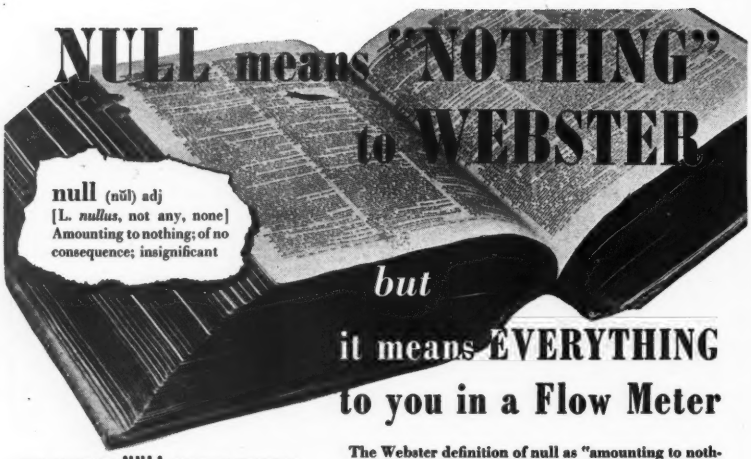
INLET END
FIBRE BOND BUSHING WITH
LEAD-SLUG INSERT

Ring above is John Crane Condenser Packing Style 603. Accurately machined to fit tube size and tube-sheet drilling. Bonds tube-end. Belling tube-end reduces aeration, produces top hydraulic efficiency. Recommended for old condensers. Cross-section shows lead-slug insert and fibre expansion ring flown into drilling . . . On the inlet end of new condensers, tube-end is expanded into tube-sheet and belled. No packing necessary.

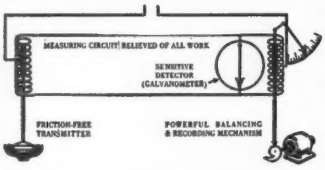
OUTLET END ELIMINATING FERRULE—Outlet ends of both old and new condensers are packed alike—eliminating ferrules. Cross-section shows installation of John Crane Endless Metallic Rings Style 601-E (special babbitt-foil) and Vulcanized Fibre Expansion Ring Style 602-G. When caulked, these rings flow inwardly around the tube and outwardly into the drilling threads, forming a perfect metallic bond between the tube and tube-sheet. Greater packing depth illustrated below.



JOHN CRANE
CONDENSER PACKINGS



THE COCHRANE NULL BALANCE PRINCIPLE


MEASURING CIRCUIT RELIEVED OF ALL WORK
SENSITIVE DETECTOR (GALVANOMETER)
FRICTION-FREE TRANSMITTER
POWERFUL BALANCING & RECORDING MECHANISM

The Webster definition of null as "amounting to nothing" is the significant point in specifying a Cochrane Flow Meter, for Cochrane design is based on the NULL balance principle, long recognized as the most accurate means of measuring a force or quantity.

It means "zero" error in the measurement of flows, temperatures, liquid levels, pH values, etc.

The null or zero balance principle consists of balancing the unknown quantity by adjusting a known quantity of the same kind, a highly sensitive indicator being used to determine the point of balance.

It is the method used in the Cochrane Electric Flow Meter, distinguishing this meter from all others.

Note: a bridge circuit alone is *not* a null method meter. A galvanometer is required to detect unbalance and an external source of power is needed to restore balance. These are found ONLY in the Cochrane Electric Flow Meter.

COCHRANE CORPORATION
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FLOW METERS

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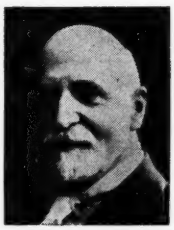
pipe. In one 7 day week the seven different gangs at work completed 54 mi.

The entire line is 1235 mi. long. The main line, from Baton Rouge to Greensboro, is 789 mi., with 526 mi. of 12-in. pipe (Baton Rouge to Bremen, Ga.) and 263 mi. of 10-in. (Bremen to Greensboro). Less than 70 mi. of 12-in. pipe were in use in gasoline pipe lines prior to the construction of this new line. Five lateral lines, one an 8-in. line to Knoxville, Tenn., and the others 4-in. lines, add another 446 mi. The main line was completed before the end of December, and by the middle of January, 1942, only 125 mi. of lateral lines were incomplete.

Only half of the pumping stations have been completed, however, because of difficulties in obtaining equipment, and the capacity of the line is now only a little more than 30,000 bbl. a day. When all the planned stations can be put in operation later in 1942, the line will carry 60,000 bbl. a day, and the addition of still more stations can increase the capacity to 90,000 bbl. if that is ever necessary.

In its first operation at half of capacity, the gasoline is moving at only about 2 m.p.h., or approximately 50 mi. a day. This speed will be doubled when all of the pumping stations have been completed. Cubic capacity of 1 mi. of 12-in. pipe is 31,000 gal.; one mile of 10-in., 21,500 gal.; 8-in., 13,800 gal.; and 4-in., 3,500 gal. The entire capacity of the main line and laterals, therefore, is about 25,525,000 gal., or 600,000 bbl.

Obituaries

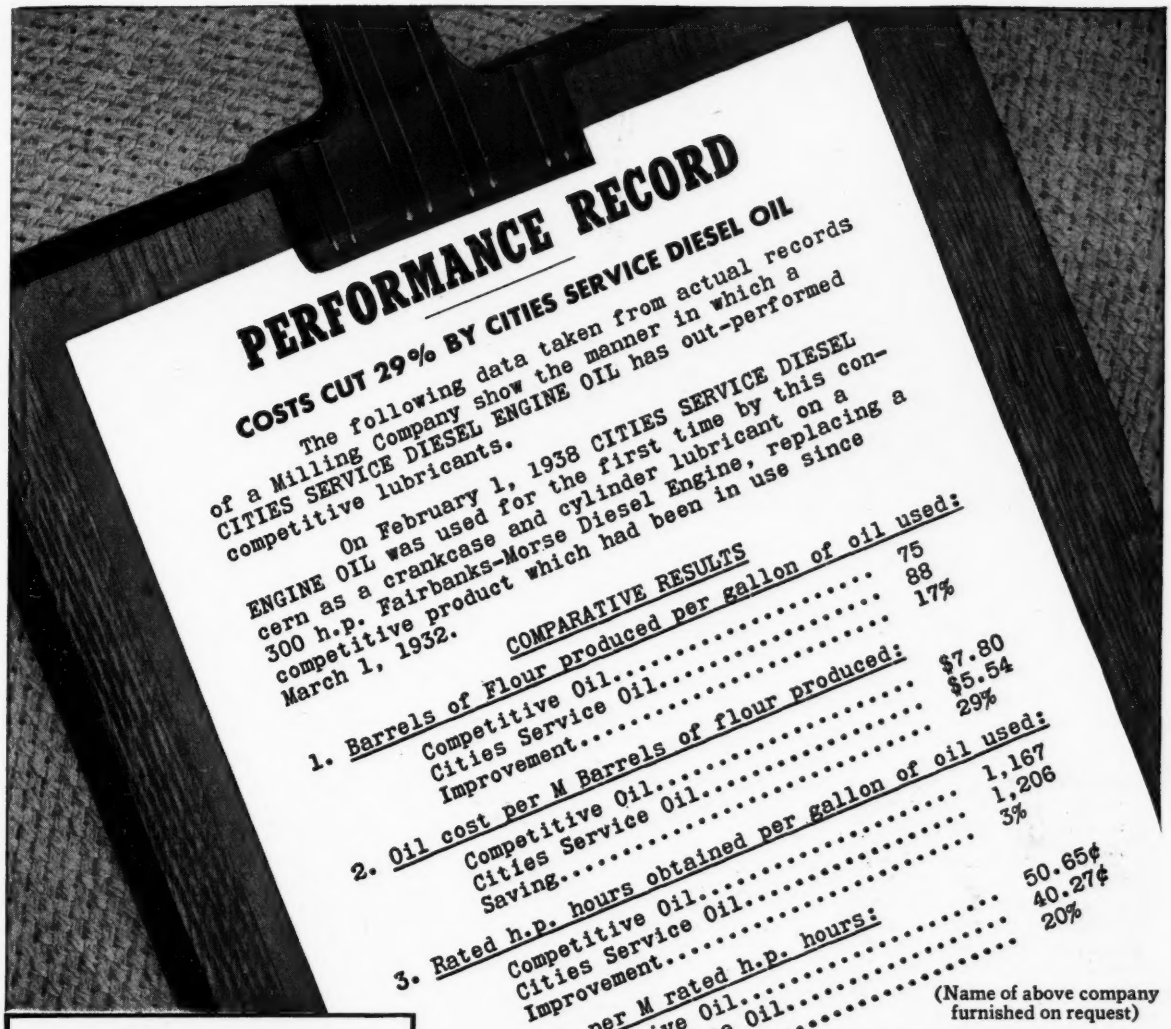


Alex Dow

Alex Dow, widely known as Dean of the Utility Industry, and frequently called Detroit's most useful citizen, died at the University of Michigan hospital, Ann Arbor, on March 22, of pneumonia.

Mr. Dow, 79, came to America from Scotland in 1882 and as a young man worked for the B. & O. Railroad, the B. & O. Telegraph Co., and the Brush Electric Co. of Cleveland. In his capacity as engineer of the latter concern, he supervised the design and construction of Chicago's South Park lighting system.

In 1893, at the age of 31, Mr. Dow was named electrical engineer of the city of Detroit and sueprvised the construction of the city lighting plant. After 3 yr. he became manager of the Edison Illuminating Co., forerunner of the Detroit Edison Co. With the latter concern he served as vice-president, and as president from 1912 until he retired in 1940. A charter member and past president of the Detroit Engineering Society, Mr. Dow was a past president of the A. S. M. E. and held membership in the A. S. C. E., A. I. E. E., and the Institution of Electrical Engineers of Great Britain. He served as engineer member of the Board of Water Commissioners for Detroit from 1916 to 1921 and from 1925 to 1932. Mr. Dow, who became a naturalized citizen of the United States in 1895, was educated in the public schools of Scotland, and received a degree in 1911 and a degree as Doctor of Engi-


PERFORMANCE RECORD
COSTS CUT 29% BY CITIES SERVICE DIESEL OIL
The following data taken from actual records of a Milling Company show the manner in which a CITIES SERVICE DIESEL ENGINE OIL has out-performed competitive lubricants.
On February 1, 1938 CITIES SERVICE DIESEL ENGINE OIL was used for the first time by this concern as a crankcase and cylinder lubricant on a 300 h.p. Fairbanks-Morse Diesel Engine, replacing a competitive product which had been in use since March 1, 1932.
COMPARATIVE RESULTS
1. Barrels of Flour produced per gallon of oil used:
Competitive Oil..... 75
Cities Service Oil..... 88
Improvement..... 17%
2. Oil cost per M Barrels of flour produced:
Competitive Oil..... $7.80
Cities Service Oil..... $5.54
Saving..... 29%
3. Rated h.p. hours obtained per gallon of oil used:
Competitive Oil..... 1,167
Cities Service Oil..... 1,206
Improvement..... 3%
4. Oil cost per M rated h.p. hours:
Competitive Oil..... 50.65¢
Cities Service Oil..... 40.27¢
Saving..... 20%

(Name of above company furnished on request)

This report of a prominent flour mill shows clearly how Cities Service Diesel Engine Oil has out-performed competitive brands. We have similar records of performance of all types of diesel equipment. If you're generating power with Diesels, you should consult a Cities Service lubrication engineer. His experience and advice may save you time and money. Write today to any of the offices listed below. There is no obligation.

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Canning	Paper
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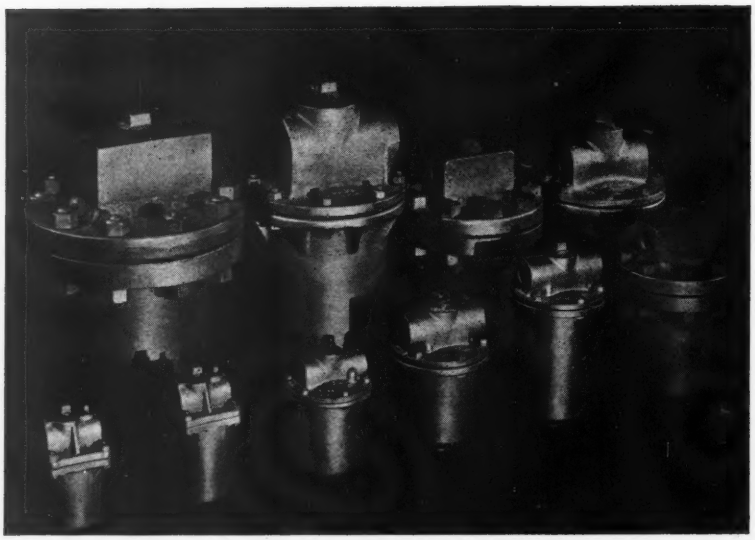
A LUBRICANT FOR EVERY INDUSTRIAL NEED



CONNECT any size SUPER-SILVERTOP AS AN ELBOW OR STRAIGHT-IN-LINE

All sizes of Anderson Super-Silvertop steam traps can be connected not only straight-in-line but also as an elbow. Regardless of the trap size needed, you can get a straight-in-line connection. Then if you change your mind you can use that same trap as an elbow connection.

This optional connection is only available with guided bucket Super-Silvertops. And this low cost ease of installation (no extra fittings to buy and install) is matched by the ease of inspection. These up-to-date inverted bucket steam traps are inspected right on the line without disturbing pipe connections.

Other good reasons for choosing Super-Silvertop traps are the extra capacity that comes from the longer bucket lever (that opens a larger valve) and the service record of long life and trouble-free operation. This record is a result of 55 years of steam trap manufacturing experience.

Let that experience and service record help you in your job—let Anderson traps save you trouble, time and money by using Super-Silvertop on every installation. Have you a copy of the useful book—"How To Choose a Steam Trap"? Then why not write for your free copy?

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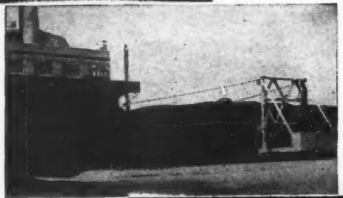
SAUERMAN POWER SCRAPERS

10 to 600 tons per hour by one man



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neering in 1924. In 1936 he was awarded a degree and in 1938 Wayne University honored him with the degree of Doctor of Arts.

Although he maintained a residence in Detroit, the Dow family home was at Barton Hills, near Ann Arbor. Mr. Dow is survived by his widow, the former Vivienne Kinnersley of Baltimore, two daughters, Mrs. Margaret Connell and Mrs. Dorothy Parker, and two sons, Douglas and Lothrop Dow of Detroit.

Edward T. Fishwick

EDWARD T. FISHWICK, vice-president and director of the Worthington Pump and Machinery Corp. died at his home in Glen Ridge, New Jersey on March 15th.

Mr. Fishwick started at the Cincinnati works of the Worthington Corporation 49 yr. ago. In addition to being senior vice-president, he was also president and director of the Worthington-Gamon Meter Company of Newark, N. J., a director of the Glen Ridge Trust Company and of the New Jersey State Chamber of Commerce, and formerly headed the Diesel Engine Manufacturers association.

Edwin F. Elzemeyer

EDWIN F. ELZEMEYER, president of the American Pulverizer Co., St. Louis, Mo., and director of sales activities for the company, died at his home in Glendale as the result of a heart attack, on February 22. Mr. Elzemeyer, who was 48, and head of the St. Louis firm since 1926, was widely known in the power plant and industrial fields. He was also a director of the St. Louis Horse Show Association and a moving force in its affairs.

Mr. Elzemeyer is survived by his widow Elda, two sons, Edwin E., Jr., and Howard W., his mother, a brother and a sister.

NEW ENGINEERING BOOKS

Training Oxy-Acetylene Welding and Cutting Operators — Instructors Outlines. The book contains 88 pp. Published by the International Acetylene Assn., 30 East 42nd St., New York, N. Y. Paper bound copies 25 ct. and the de luxe edition, cloth bound, 75 ct. The new book was prepared primarily to assist instructors in planning courses for the training of oxy-acetylene welding and cutting operators. Divided into three chapters, the book first outlines the essential information that should be presented in a course for the training of a general welding operator, an aircraft-welding operator, and a pipe-welding operator; the second chapter contains in outline form the material that is essential to the training of various types of cutting operators and the third chapter outlines the essential information that should be given in a course for inspectors and a specification of the primary requirements of students who take the inspector's

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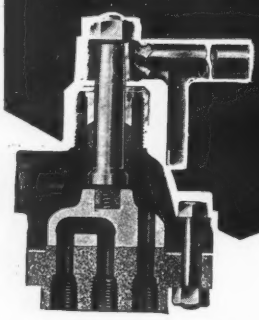

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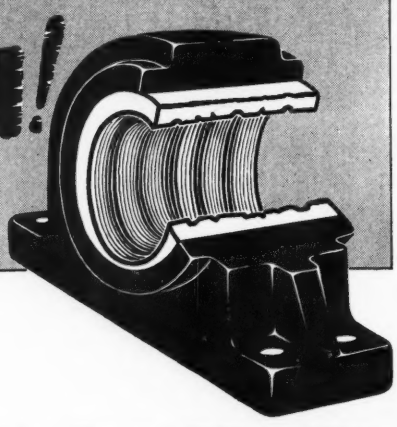

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MAGNOLIA BEARING METALS

course. Furthermore, these outlines furnish the basis for many other types of specialized courses, and suggestions for completing these are included.

The material presented has been divided into self-contained units, each of which includes the four essential parts of any particular lesson, namely, an outline for a classroom lecture, suggestions for study assignments, recommendations for the material that should be demonstrated and discussed, and a description of the practice exercises the student should do in the shop. Recommendations for qualitative testing of the work done are included throughout the book. An introduction describes in considerable detail the organization of the book and gives suggestions for its use.

Optimum Air-fuel Ratios for Liquefied Petroleum Gases. By W. H. Paul and M. N. Popovich. Published as Bulletin Series No. 14 by the Engineering Experiment Station, Oregon State College, Corvallis, Oregon. Size 6 by 9 in., 18 pp., paper bound. Price 25 ct.

This bulletin reports an investigation on the determination of optimum power and economy air-fuel ratios for propane, n-butane, iso-pentane, iso-octane, gasoline, and commercial mixtures of butane and propane. It also includes calibration of a commercial thermal conductivity type air-fuel ratio instrument for each of these fuels, with an explanation of the unreliability of such instruments in the lean-mixture range.

Tests show that the optimum air-fuel ratio for maximum power varies from 13 lb. of air per pound of fuel for gasoline to about 15.6 for propane. For minimum fuel consumption the optimum ratio is about 16 for gasoline and about 17.9 for propane. With few exceptions the points fall on a smooth curve when the air-fuel ratio is plotted against per cent of carbon in the fuel.

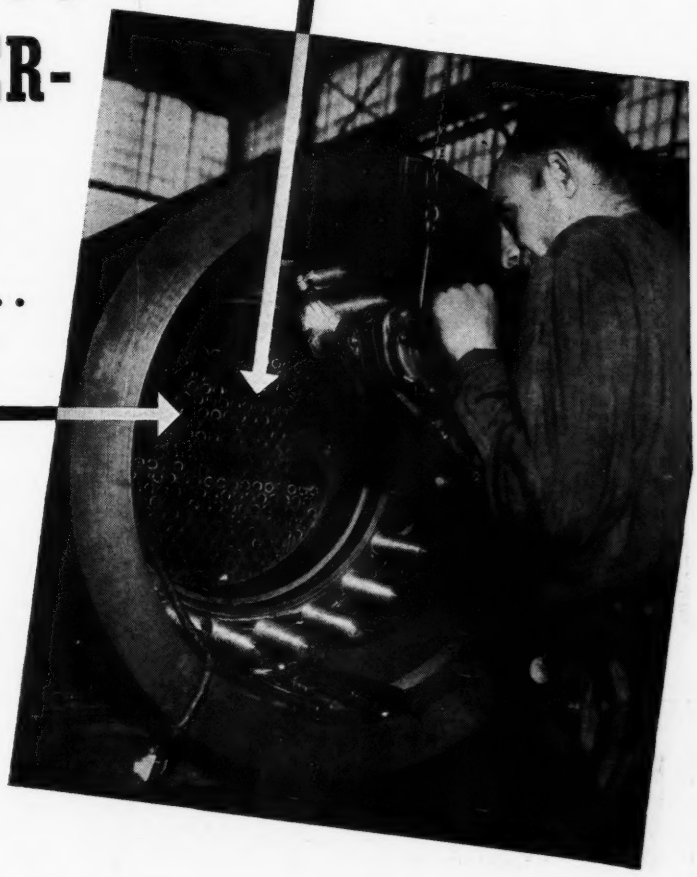
Steel Products Manual. Size 6 by 9 in., from 50 to 100 pp. per section, paper bound. Published by the American Iron and Steel Institute, 350 Fifth Ave., New York City. Price 25 ct. per section.

The Steel Products Manual consists of a series of some 33 sections covering various iron and steel products. To date 25 sections have been printed. The last four, covered by this review, include Section 8 on Hot Rolled Carbon-Steel Bars, 9 on Cold Finished Steel Bars and Shafting, Section 10 on Alloy Steels, and Section 15 on Hot-Rolled Carbon-Steel Wire Rods. While the order varies somewhat from section to section each booklet is divided into several parts dealing with general definitions, manufacturing practices and industry standards, including methods of sampling and check analysis.

Priorities and Allocations. Copyright 1942, 90 pp., size 8½ by 10 in. paper bound. Compiled and published by The Research Institute of America, Inc., 292 Madison Ave., New York, N. Y., as Research Analysis 18. Price $1.00.

This is a comprehensive manual of the priority and allocation system arranged as practical guide to business operations under the most complicated tangle of red tape that American industry has ever hade to cope with. How to get priority controlled materials, fit priority orders into production sched-

MONEL tubing proves O.K. in SUPER-PRESSURE PRE-HEATER...



Now in use for nearly a year, this strong, corrosion-resistant metal fulfills expectations at Twin Branch

Designing a unit to generate steam at the record-breaking pressure of 2,500 lbs. called for something unusual in feed water pre-heaters. What *tubing* to use in the latter posed a problem for Indiana & Michigan Electric Co. and Foster Wheeler Corp.

The feed water heater at their Twin Branch plant handles 550,000 pounds of water per hour, at temperatures ranging from 353 to 490° F., under a pressure of 3,200 p.s.i. Maximum steam pressure and temperature *outside* the tubes are 700 p.s.i., 650° F.

Possessing a high rate of heat transfer and the corrosion-resistance and strength necessary to secure a tube of moderate thickness, Monel has proved entirely satisfactory. In this and numerous other ways INCO Nickel Alloys are helping meet demands for increased production of Power.

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★ ★ ★ ★ ★ **INCO NICKEL ALLOYS** ★ ★ ★ ★ ★

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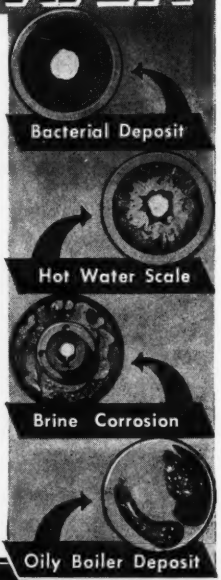
Let us study these problems for you and tell you how Chrom Glucosate, Phospo Glucosate, and many others of our Haering products can correct these conditions, saving your materials and increasing the production of your plant.



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"Cooling Waters" • "H-O-H Lighthouse Reprints'
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ule, extend ratings down to subcontractors and handle inventions, inspections and check ups are of necessity a primary concern of all who expect to continue in business.

The book begins with an explanation of the priority and allocation system and continues, in a logical, clear cut manner, to explain the application of the system to actual business conditions: How to get a rating; blanket ratings; ratings for individual contracts; distributor, construction, maintenance, operation, and export; what to do about rated orders; how commodities are allocated; how to prepare for policing of, and inventory inspections and checkup; whom to see on priorities; how to adapt your business to the new conditions; and what's ahead on priorities.

Last in the book is a list of M, L and PD orders in chart form. Inasmuch as the book was published in January this section is not up to date. This data as of January 30 (with a supplement carrying it to Feb. 15) is contained in "Priorities Orders in Force" compiled and issued by the Div. of Information, Office of Emergency Management, Washington, D. C. Supplements keeping the data up to date are published weekly by the E.O.M. Weekly Magazine, Victory (Supt. of Doc. price 75 ct. per yr.) Price schedules from 1 through 105 will be found in Part II of the Federal Register for Feb. 21, 1942 (Supt. of Documents, $1.25 per mo. or 10 ct. per copy.)

Priorities and Allocations, together with the next book reviewed, Producing For War, represents a radical break in precedent for the Research Institute in that they are the first distributor of reports outside the membership. An example to the rule was made in these two cases due to the widespread importance of the reports in the present emergency.

Producing for War. March 1942, 115 pp., size 8½ by 10 in. paper bound. Compiled and published by the Research Institute of America, Inc., 292 Madison Ave., New York, N. Y., as Research Analysis 20. Price $2.00.

No single book we know of comes as close to answering all questions about industrial conversion to war purposes as does this well arranged and carefully compiled volume. Donald Nelson recently warned American industry to "Convert or Perish", and made it clear that the conversion job was one for individual effort and that the W. P. B. could not undertake to do the job for each of the 184,000 manufacturers of the country.

The practical value of the book is well shown by a glance at the chapter headings: Convert to war production; where to go for a war job; how to get war contracts; your war sales kit; how to get a subcontract; financing war work; drafting and operating under a government contract; taxes on government contracts; improve operating methods; work around the clock, and maintaining labor supply.

Among other things are addresses and functions of the various purchasing units of the Army, Navy, Maritime Commission, Treasury Department and Lend-Lease buying. Each section is arranged so as to be easily found and quite complete in itself with, in each case, observations or recommendations dealing with that particular case.

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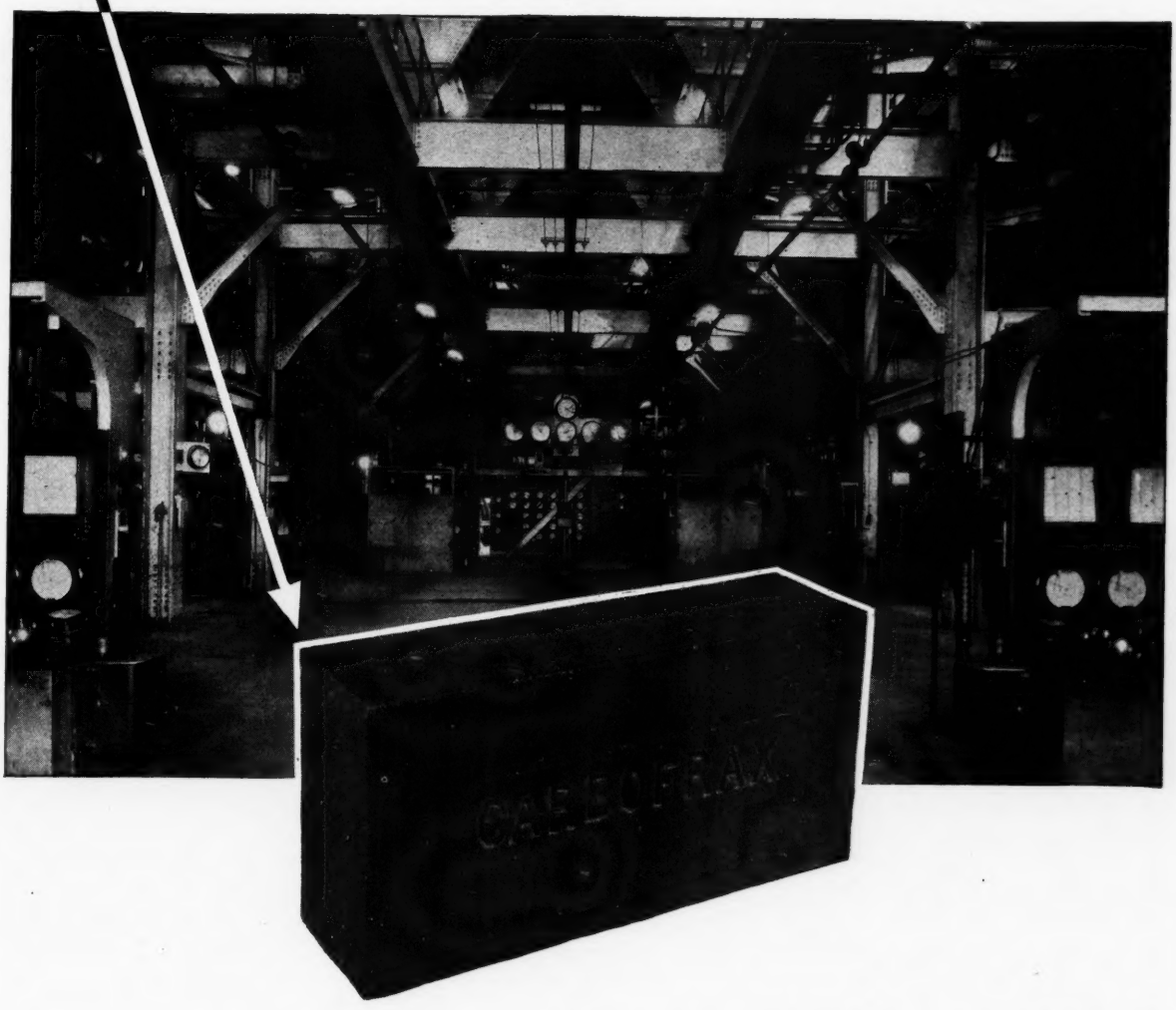

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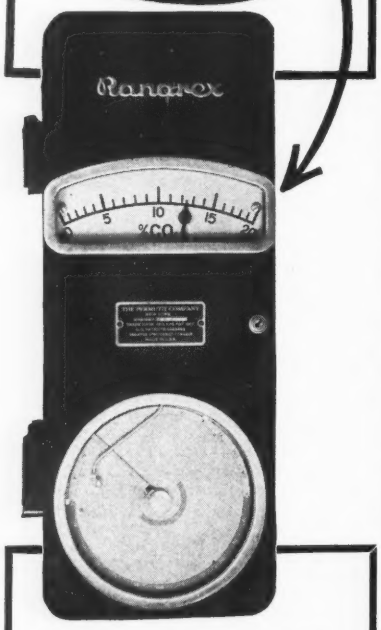

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Electrical Supply Lines, a section from the Handbook of Safety Rules on Supply Lines, a revision of H 10 and a part of the National Electrical Safety Code, is available from the Supt. of Documents, Government Printing Office, Washington, D. C. Price 65 ct.

All About Me. By J. M. Bruer. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Size 8½ by 11 in., 89 pp., spiral wire, paper binding. Price $1.00.

This book, written by the co-ordinator of the Rochester, Minn. High School, is largely a compilation of forms for personal data which a person should collect and have axailable for purposes of employment, credit ratings, social security, naturalization, etc. Completed, it is intended to provide the full life story of an individual including birth certificates, education and training, school records, employment record, references and recommendations, physical fitness and various standard forms used for vocational training, employment application, surety bonds, apprenticeship agreements, etc.

Design of Piping for Flexibility With Flex-Anal Charts. By E. A. Wert and S. Smith. Copyright 1941, 2nd Edition, size 11¼ by 8¾ in. 96 pp., spiral Fabrikoid bound. Published by Blaw-Knox Co., Power Piping Division, 2042 Farmers Bank Bldg., Pittsburgh, Pa. Price $3.00.

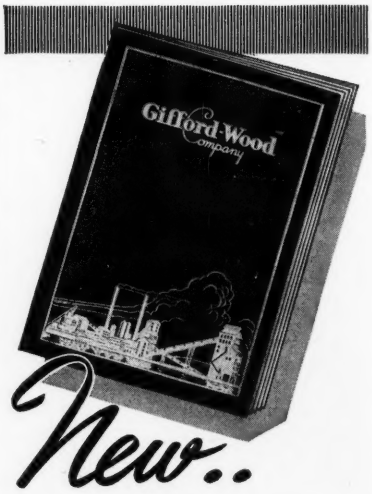
This book is intended for the experienced pipe design engineer who can, by the use of the method and application of the Flex-Anal Charts, accurately analyze any piping system in a very short time. Details of piping design for flexibility which has always required a considerable amount of intricate calculation to obtain a satisfactory solution and more so with the increase of temperatures and pressures now being demanded by the power industry and oil refineries, have been simplified through practical piping layout dealt with in this book.

The curves, tables and formulas of the Flex-Anal charts, when properly applied can be used to quickly determine the proper general design of the piping structure before an appreciable amount of draft-room time has been uselessy expended, and also will provide the piping design engineer with a simple method whereby rapid, accurate, and complete flexibility analyses can be made for previously determined shapes.

Although the formulas developed in this work apply to all practical materials, for use at any temperature, the charts and tables, however, are confined to low and medium carbon steels, low alloy content steels, and wrought iron, for use at temperatures up to 1000 deg. F.

Possible Alternates for Alloy Steels. Size 6 by 9 in., 143 pp.. paper bound. Published by the American Iron and Steel Institute, 350 Fifth Ave., New York, N. Y. Price 50 ct.

This is No. 5 of a series of bulletins, entitled Contributions to the Metallurgy of Steel. The complete title is Possible Alternates for Nickel, Chromium and Chromium-Nickel Constructional Alloy Steels. It was prepared at the request of the OPM (succeeded by the WPB) and the purpose was to



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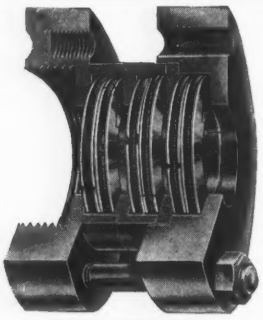

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Power Plant Engineering and Design. By Frederick T. Morse. Second edition, Copyright 1942, size 6 by 9 in., 687 pp., cloth bound. Published by D. Van Nostrand Co., Inc., 250 Fourth Ave., New York City. Price $6.50.

The first edition of this book appeared in 1932 and was characterized by two important features. First, it presented in one volume a rather comprehensive study of electric generating stations including public utility, industrial and institutional plants from the standpoint of steam, Diesel and hydroelectric power. Second, the steam plant section was exceptionally well treated from the standpoint of cycles, the combustion loop and the feedwater loop. While intended primarily as a college text, the method of presentation made the book of value to the practical engineer already familiar with applied thermodynamics.

The make-up and arrangement of the second edition closely follows that of the first but about half of the text has been rewritten and the illustrations revised to supersede it from the standpoint of the practical engineer revision is important in that the gap between theory and practice has been narrowed, application emphasized so that the text may be considered as a book on applied thermodynamics as reflected by contemporary practice.

The book may be considered as divided into three general sections, the last dealing with electric system equipment and layout, the middle section with steam plant cycles, equipment and theory and the first part devoted to general power practice, including Diesel engine power and hydroelectric power and practice.

Introductory chapters cover important topics not generally considered in the average text. Such matters as the scope of steam plant engineering, variable load problem, power plant economics and the power plant building.

The author is Associate Professor of Mechanical Engineering at the University of Virginia, Charlotteville, Va.

American Standards 1942. This is a price list distributed free of charge by the American Standards Association, 29 West 39th St., New York City. This new list includes nearly 500 Standards in the industrial field and in public safety. There is a new separate listing for Defense Emergency Standards, that is standards developed specifically

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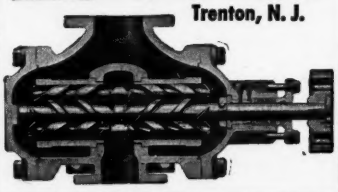

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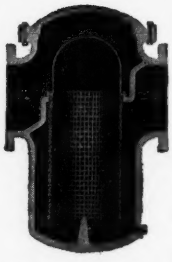

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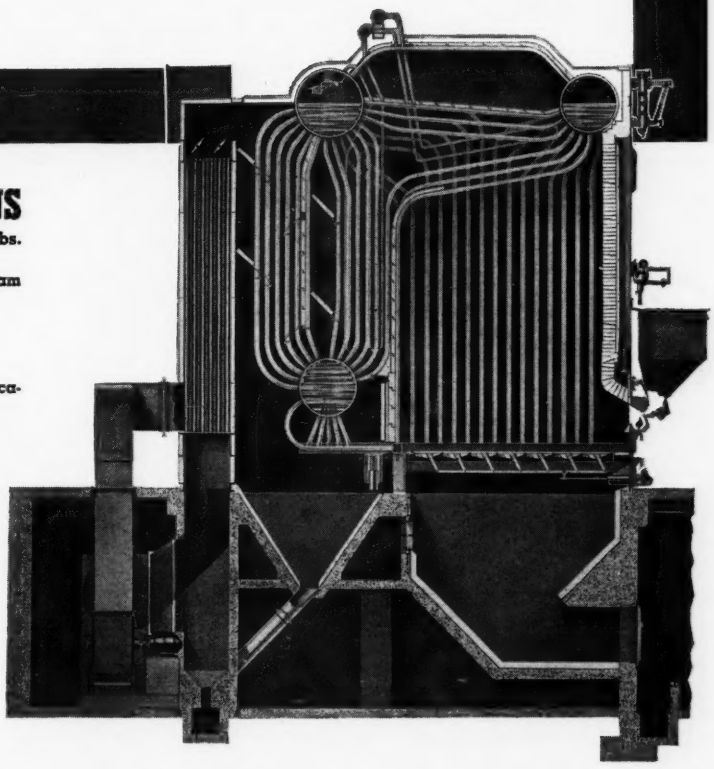

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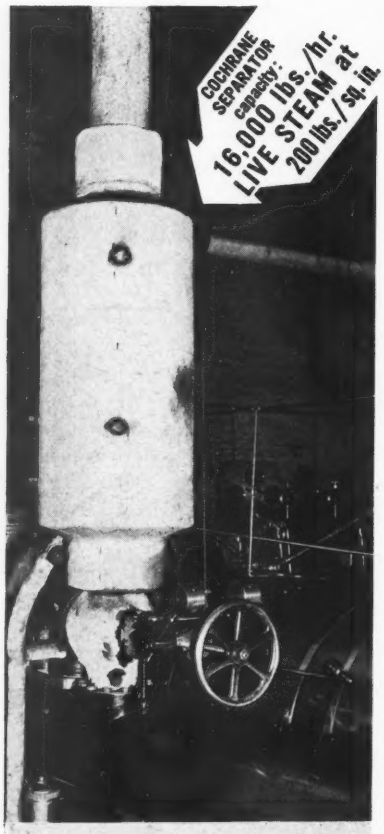

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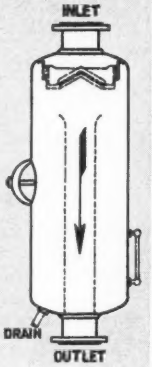

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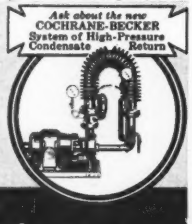

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for defense purposes. Other standards include definitions of technical terms, metals and other materials, methods of test, dimensions, safety provisions and methods of work.

Engineering as a Career. Copyright 1942. 6 by 9 in., 36 pp., paper bound. Prepared and published by the Engineers' Council for Professional Development, 29 W. 39th St., New York City. Price 10 ct.

Planned to help high school students decide whether they are fitted to be engineers, this pamphlet gives readers a general picture of the characteristics and requirments common to all branches of the profession and discusses the qualities and aptitudes needed by engineers. Since E.C.P.D. is sponsored by eight of the leading professional engineering societies in the United States and Canada, the opinions expressed are those of practitioners desirious of advancing the standards of the profession. Part I is a brief summary of the scope of engineering. Part II deals with the principal branches of engineering as practiced today, and Part III is a list of references to vocational guidance literature.

National Foremen's Institute, Inc., Deep River, Conn., has recently published two 5 by 8 in. pamphlets intended primarily for distribution to company employes. The first, 11 p. is, Who Wants The Closed Shop, by Russell L. Greenman. Prices range from 25 ct. each for 1 to 10 copy lots, down to 10 ct. each for lots of 501 or more, minimum order $1.00. The second is an 8 pp., concisely written, well illustrated folder by H. D. Farren entitled How to Fight Fires Resulting from Air Attacks. Price $3.75 per 100.

Specifications for Mineral Wool Insulation—The Industrial Mineral Wool Institute has adopted and released Specification No. 1 on Mineral Wool in Low Temperature Installations, compiled by its Technical Committee and which has the approval of the engineering staffs of the principal mineral wool insulation manufactuerrs. This 8 p., 8½ by 11 in. book covers material specifications, specifications for surface preparation of areas to be insulated, individual specifications for the application of mineral wool insulation on walls, floors, ceilings, piping, fittings, etc. Twelve engineering-drawings in perspective illustrate Institute approved methods of applying mineral wool insulation, providing the necessary vapor barrier, supporting and finishing off the insulation in various applications. Copies may be secured without charge from Richard L. Davis, Secretary, Industrial Mineral Wool Institute, 441 Lexington Ave., New York, N. Y.

N. A. F. M. Fan Standards. This is a new 12 pp. 8½ by 11 in. bulletin, the third edition of N. A. F. M. Form X-12, giving the Standards adopted for centrifugal fans and blowers included for air conditioning, heating, ventilating, and general air handling problems. Working data, a comparison of different manufacturers designs, air density, ratios at various altitudes and temperatures and cynical specifications are included. Distributed free of charge upon request to the National Association of Fan Manufactuerers, 5-208 General Motors Bldg., Detroit, Mich.

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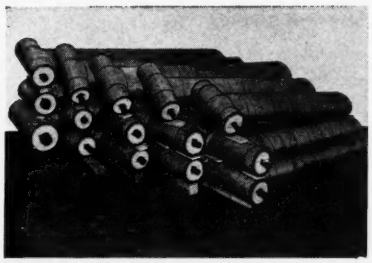
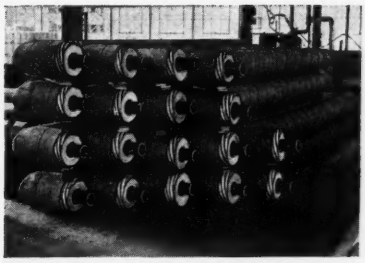
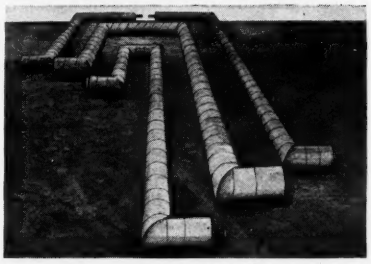


Hairpin expansion loops for flanged units

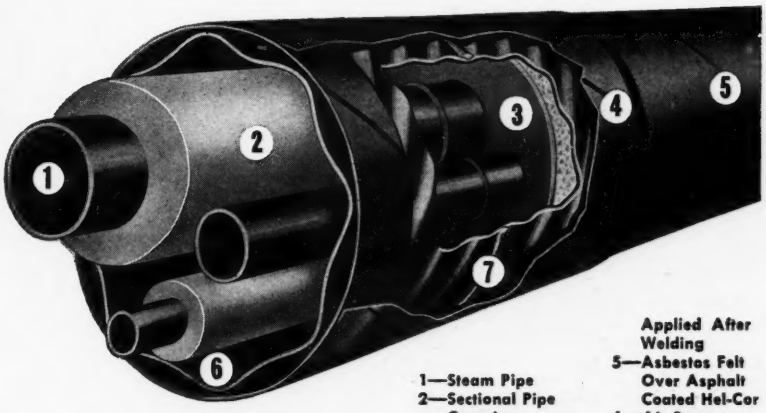


Each of these is half of a large expansion U-bend

Insulating expansion fittings



Expansion bends with offsets



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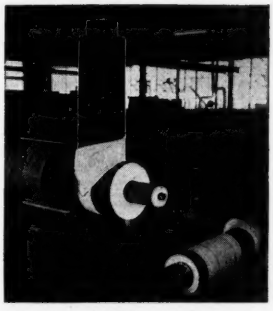

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1 **Rotary Switches**—Rotary type instrument, control, transfer and auxiliary switches are described, illustrated and various combinations listed in a new 16-p. Catalog 7140. Roller-Smith Co.

2 **Switchgear**—GEA-3742 shows typical installations of various metal-enclosed switchgear equipment. Included are illustrations of application and arrangement for this equipment. General Electric Co.

3 **Switchgear**—GEA-3672 describes the simplicity of metalclad switchgear and the ease with which interconnected studs can be quickly located without first tracing the connecting lead. General Electric Co.

4 **Switchgear**—GEA-3658 illustrates and describes FH Cubicles with air-blast breakers in a recently released 24-p. catalog. The compact, segregated-phase switchgear mentioned is for power station service up to 23,000 v. and 2,500,000 kv-a. General Electric Co.

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7 **Transformers**—Bulletin No. PS-405 is a catalog presenting the complete line of UTC transformers for communication, laboratory, and replacement purposes. Each of the UTC lines described is distinguished by individual characteristics ideally suiting the items to the specific application intended and of interest to anyone engaged in electronic work or development. United Transformer Co.

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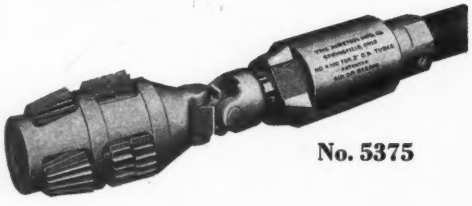

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12 Photoelectric Relays—For industrial application and general purpose use, photoelectric relays, light sources and phototube housings are covered in a new 6-p. bulletin entitled Descriptive Data 18-310. The bulletin includes electrical characteristics, light requirements, rate of operation, time delay, sensitivity and control. Westinghouse Electric & Mfg. Co.

13 Insulated Cable—Coronol (R351) the ozone-resistant cable insulated with a G-E oil base compound and recommended where a long-lived, high voltage rubber cable is desired, is illustrated and described in Bulletin GEA-1788B. General Electric Co.

Instruments and Controls

14 Electrical Equipment—Catalog No. 1101G, profusely illustrated, describes electrical and control equipment of the Tagliabue electrical line, specifically the high speed photoelectric Celectary pyrometers. Detailed specifications are also included. C. J. Tagliabue Mfg. Co.

15 Instruments—Bulletin No. Z5000, is a 12 p. condensed catalog of Wheelco instruments, potentiometers and other equipment, including thermocouples, thermometers, flame-otrols, program controls, proportioners and various electric and photoelectric controls. Wheelco Instruments Co.

16 Instruments—Booklet GES-2543 describes concisely the application of extremely sensitive yet sturdy electric gaging equipment such as the strain gage, pressure gage, film-thickness gage, eccentricity gage, profile gage, electrolimit gages and the tensiometer. General Electric Co.

17 Instruments—Recent improvements in Micromax CO_2 recording equipment are described in a 16 p. revised catalog N-91-163. In addition to a complete description of the equipment, the catalog contains full-size colored reproductions of round and strip-chart records and illustrations of installations. Leeds & Northrup Co.

18 Electric Control—A new 4-p. bulletin, No. 1705 describes Jagabi Lubri-tact Laboratory Rheostats. One of the distinguishing features of these rheostats is a graphite lubricated contact designed to eliminate wear and give smooth adjustment. James G. Biddle Co.

19 Electric Control—Booklet 930 illustrates and describes the all a.c. frequency relay crane control for hoist, bridge and trolley motions through Dynamic Lowering Control and Contra-Torque Lowering Control. Electric Controller & Mfg. Co.

20 Speed Control—Bulletin B6013A illustrates and describes the Vari-Pitch Speed Changer which handles units from 1½ to 75 hp. to step up production from available machine capacity by increasing machine flexibility with instant, positive speed control. Diagrams, operating data and selection tables are also included. Allis-Chalmers Mfg. Co.

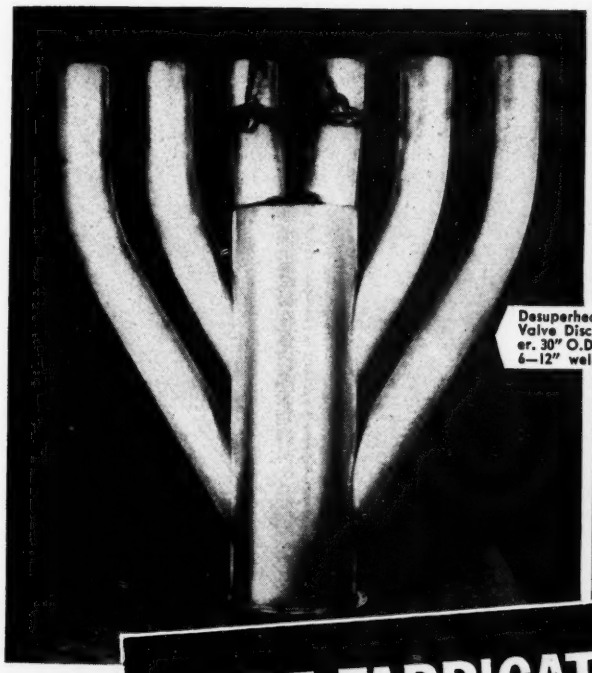
21 Speed Control—More Output for Defense is the title of a 16-p. booklet G-423 covering numerous uses and applications for Reeves variable speed control equipment in defense industries and plants on different types of machines. Reeves Pulley Co.

22 Pressure Recorder—Factual information contained in Catalog 22-A is arranged for convenience in selecting the pressure recorder best suited to particular needs. The catalog covers instruments for the measurement and recording of industrial pressures of all kinds, in ranges from 1 in. w.g. to 20,000 lb. The Foxboro Co.

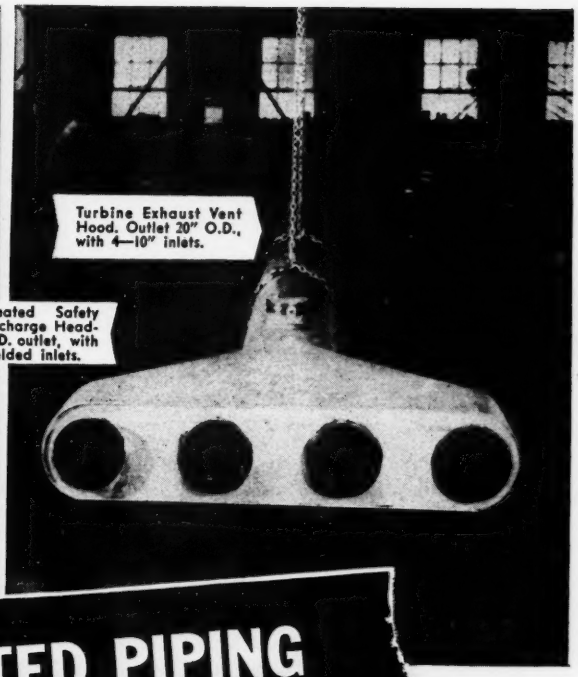
23 Recorders—Illustrated and described in a 12-p. Bulletin GEA-3187C is the Type CF portable inkless strip-chart recorder. Complete with features and applications, the bulletin also shows a comparison between the ink and inkless recorders on typical records. General Electric Co.

Metal Alloys

24 Metal Alloys—Lead and tin products made from various alloys and solder and other specialties including extruded shapes, pipe and tubing are covered in a new 4-p.



Desuperheated Safety Valve Discharge Header. 30" O.D. outlet, with 6—12" welded inlets.



Turbine Exhaust Vent Hood. Outlet 20" O.D., with 4—10" inlets.

PRE-FABRICATED PIPING

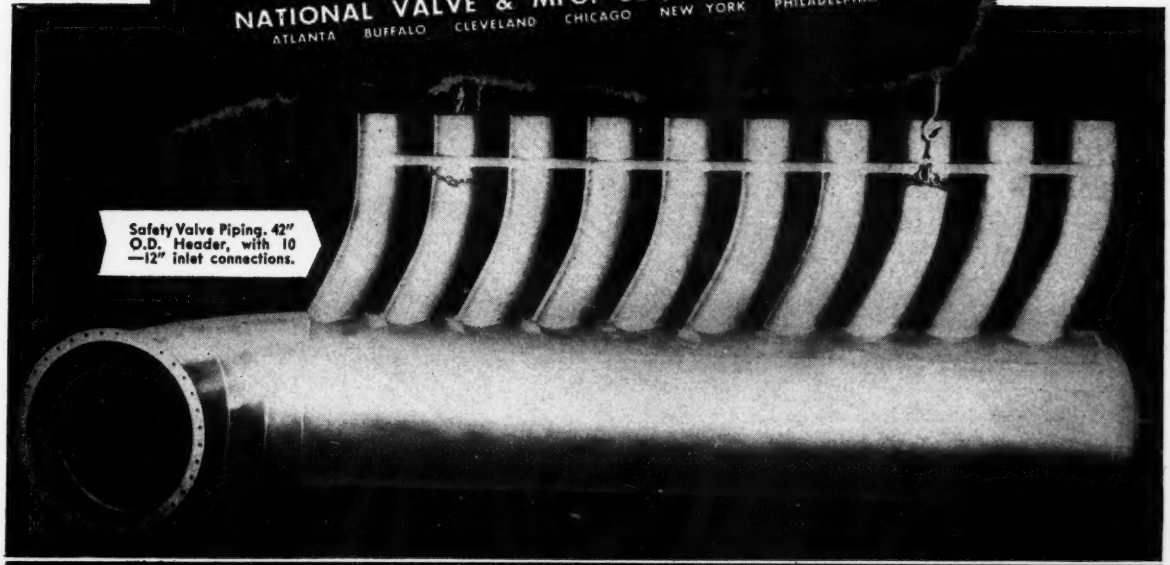
There are many advantages in shop fabricating such assemblies as shown here. Better control of welding is afforded — Economies are effected — Closer tolerances can be maintained.

The extensive facilities of Navco Shops insure reasonable deliveries even in these days of Defense Programs and Priorities.

Whether you require just a single pipe bend or a completely installed system, Navco will be glad to serve you.

NATIONAL VALVE & MFG. CO., PITTSBURGH, PA.

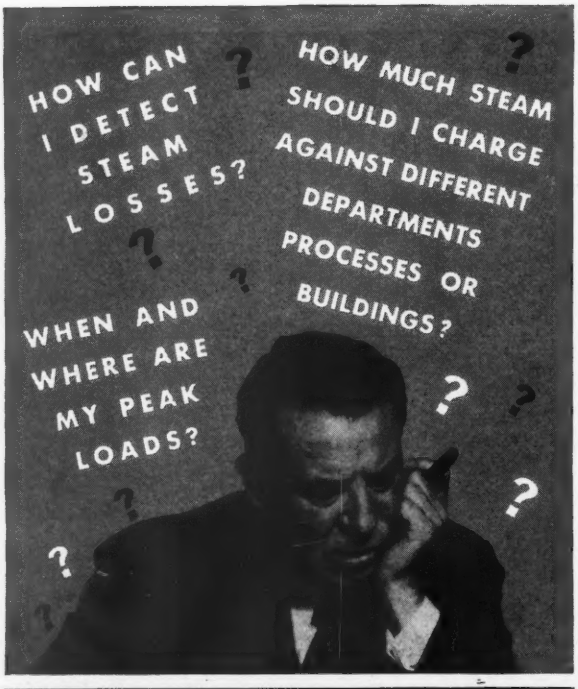
ATLANTA BUFFALO CLEVELAND CHICAGO NEW YORK PHILADELPHIA



Safety Valve Piping. 42" O.D. Header, with 10 —12" inlet connections.

NAVCO PIPING

NAVCO


HOW CAN I DETECT STEAM LOSSES?
HOW MUCH STEAM SHOULD I CHARGE AGAINST DIFFERENT DEPARTMENTS PROCESSES OR BUILDINGS?
WHEN AND WHERE ARE MY PEAK LOADS?

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ROTARY CONDENSATION METERS
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Making "UP-TO-DATE" Steam Line Equipment For Over 60 Years

folder dealing specifically with the use in, and requirements for, defense industries. Data on composition, melting points, gravity and density of various lead and tin alloys are included. Alpha Metal & Rolling Mills, Inc.

25 **Metal Alloys**—A single 8½ by 11 in. sheet shows in parallel columns Federal, Navy, Aircorps, AMS, S.A.E. and A.S.T.M. specifications, chemical composition and the corresponding Ampco designation for 18 different bronze alloys. Ampco Metal, Inc.

26 **Alloy Steel**—Technical Information on Worthite is the title of 12-p. Catalog W-350-B4A which gives the general, physical and electrolytic properties and analyses of Worthite, a high-nickel high-chromium molybdenum low-carbon alloy steel which contains less than 50 per cent iron and suitable for use with a wide variety of corrosive solutions. Worthington Pump & Machinery Corp.

27 **Brass and Bronze**—Practical Data on Brass and Bronze Castings is a new booklet on standard specifications, applications and other related information dealing with brass and bronze castings. Complete chemical analyses and physical properties are given, along with microphotos and Army, Navy and S.A.E. Specifications, A.S.T.M. definitions of standard terms and tables of physical constants. Hammond Brass Works.

Pumps and Compressors

28 **Centrifugal Pumps**—Bulletin 238 describes 4, 5, 6 and 7 stage Thrustfre centrifugal pumps, built in capacities up to 1700 g.p.m. and pressures up to 1200 lb. per sq. in. Complete with specifications and cross sections of various pumps, showing details of design with particular emphasis on the non-leakage dynamic hydraulic balance. Pennsylvania Pump & Compressor Co.

29 **Pumps**—Single and 2-stage horizontal dry vacuum pumps equipped with feather valves and tapered roller bearings are illustrated and described in Bulletin L-710-B1. Worthington Pump & Machinery Corp.

30 **Compressors**—A new 6-p. Bulletin H-621-B8 illustrates and describes the type VS vertical single cylinder, single stage, air or water cooled air compressors built in sizes up to 66 c.f.m. and for pressures up to 175 lb. Included are construction features, specifications and dimensions. Worthington Pump & Machinery Corp.

31 **Air Compressors**—Bulletin H-620-B16F is an 8-p. treatise on 2-stage, air cooled, radial air compressors of 80 to 125 lb. pressure. Included are dimensions, specifications and construction features. Worthington Pump & Machinery Corp.

Piping and Fittings

32 **Flexible Metal Hose**—Bendix Bulletin H-201 gives complete information about Eclipse Seamless Flexible Metal hose, widely used for handling alcohol, grease, hot liquids, oil, steam and other non-solids where flexing and vibration are encountered. Bendix Aviation Corp.

33 **Piping**—Genuine wrought iron pipe and tubular products, wrought iron hot rolled products, welded steel tubular products, and standard steels and high heat resisting steels are given technical treatment in Byers 1942 General Catalog. The catalog also contains numerous tables giving shapes, dimensions, weights and other data used in the selection of these products for industrial purposes. A. M. Byers Co.

34 **Pipe Hangers**—A new 8-p. bulletin describes Crawford adjustable steel pipe hangers, concrete inserts, clamps, rolls and saddles. This is a section of the company's complete catalog No. 38. Crawford Company.

35 **Flexible Pipe**—An 8-p. illustrated bulletin, No. 71, gives 1942 standard data on Penflex all metal flexible pipes for Diesel installations. These all metal assemblies are rec-

IT'S "ALL-OUT"

even to cinders - in these plants!

Partial List of Recent Installations

Calco Chemical Div. of American Cyanamid Company
Campbell Soup Company
Cincinnati Milling Machine Company
Continental Paper Company
General Electric Company
New York Navy Yard
Castanea Paper Company
Southern Colorado Power Company
City of Decatur, Ind.
Federal Housing Projects and Veterans Hospitals

When you push stoker fired boilers at high ratings in an "all-out" for victory, there is no need of pushing cinders out of the stack and sprinkling men, machines, and materials with dirty particles. Take them "all out"* of the flue gases — with Green Cindertraps.

As these cindertraps are of the gravity baffle type and have no moving parts, there are no power costs. As the velocity of the gases passing through the baffles is relatively low — as no water is used in any part of the system, there is but little wear or corrosion — practically no maintenance.

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* Recoveries obtained *in service* have been as high as 90 per cent by weight of the total — draft loss, 0.1 to 0.2 inches.

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BEACON NEW YORK

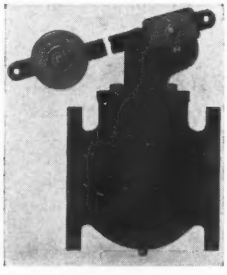
MECHANICAL DRAFT FANS · AIR PREHEATERS · ECONOMIZERS · CINDERTRAPS

Automatic RELIEF VALVES for Every Job

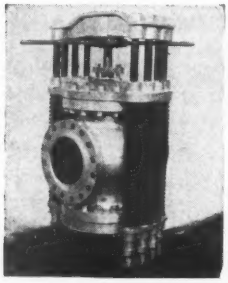
PRESSURE RELIEF • VACUUM RELIEF
ATMOSPHERIC RELIEF • PUMP BYPASS

THE DAVIS LINE (Standard Items)	For Steam, Air and Gas *Also Water and Oil											For Steam									
Valve No.	13R	14R	15R	16R	18R	*19R	49	180R	182R	260	*261	401	80	81	82	110 111B	111 112	113	113B	116 117	118B	265
Service: Pressure Relief to Atmosphere												✓	✓	✓	✓				✓		✓	
Service: Pressure Relief into L. P. Lines		✓	✓	✓																		
Service: Vacuum Relief		✓	✓	✓	✓	✓																
Service: Pump By-Pass	✓							✓														
Service: Protection of Major Equipment										✓	✓					✓	✓	✓	✓	✓	✓	✓
Max. Relief Pressure	100	150	30	125	50	100	200	150	500	50	15	500	20	20	20	Atmos.	Atmos.	Atmos.	10	Atmos.	10	250
Single Seat	✓					✓	✓			✓	✓					✓	✓	✓	✓	✓	✓	✓
Double Seat		✓	✓	✓				✓	✓			✓	✓	✓	✓							
Diaphragm Actuated	✓	✓	✓	✓	✓	✓		✓														
Piston Actuated									✓													
Direct Disc Actuated										✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Auxiliary Pilot Control																						
Spring Loaded	✓	✓				✓	✓	✓	✓	✓	✓	✓										✓
Weight Loaded			✓	✓	✓								✓	✓	✓				✓		✓	
Range of Sizes, Scr'd.	⅜" 2"	½" 4"	½" 4"	½" 4"	½" 4"	½" 4"	½" 4"	½" 4"	½" 4"	2" 4"	2" 4"	½" 4"	2" 6"	2" 6"	2" 6"							
Range of Sizes, Fl'g'd.		1½" 14"	1½" 14"	1½" 14"	1½" 14"	1½" 14"	1½" 14"	1½" 14"	1½" 14"	2" 8"	2" 8"	1½" 14"	2" 24"	2" 24"	2" 24"	6" 30"	6" 48"	6" 30"	6" 30"	6" 30"	6" 30"	4" 20"
Material Specifications: Bronze	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										
Material Specifications: Semi-Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Material Specifications: Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓										✓
Material Specifications: Iron Bronze	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Material Specifications: Nickel Iron		✓		✓			✓					✓										
Material Specifications: Monel	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓										
Material Specifications: Stainless Steel	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓										✓

USE the check list above to determine the proper type of relief valve for your job. It lists valves suitable for every relief service, including valves designed for full pipe capacity at rated relief pressure with minimum accumulation. Hand testing levers may be incorporated on most designs. Manual control and stay-open features are available on atmospheric relief valves. Send data on your service conditions for complete recommendations on the proper valves for your plant. DAVIS REGULATOR CO., 2508 S. Washtenaw Ave., Chicago, Ill.



Above—No. 80 "Noiseless" semi-balanced Back Pressure Valve for exhaust lines.



Right—No. 110 Exhaust Relief Valve for condenser protection service.

Left—No. 265 Turbine Bleeder and High Pressure Relief Valve.

DAVIS AUTOMATIC VALVE SPECIALTIES

ommended for exhaust pipes, air intakes and supply lines. Included is a guide to the requirements of U. S. Government Departments, the Navy, Coast Guard, etc. Pennsylvania Flexible Metallic Tubing Co.

Bearings and Lubrication

36 Bearings—4-p. Bulletin No. 11-C describes cast iron covers for ball and roller bearings; explains their advantages and low unit cost in either small or large quantities, and savings made possible by the elimination of costly machine set-ups. Detailed drawings, sizes and styles are also included. R-S Products Corp.

37 Oil Purifier—Honan-Crane continuous oil purifiers for steam turbine and hydro-electric oil are treated in Bulletin 300-T which points out how lubricating oils deteriorate and describes how they can be maintained in reliable condition. Honan-Crane Corp.

38 Lubrication—A convenient, topic-indexed, 72-p. lubrication recommendation Handbook No. 1585 contains complete automotive lubrication recommendations, crankcase recommendations for above and below 32 deg. F. for industrial, marine, aviation engines, fire apparatus, motor busses and motorcycles. Valvoline Oil Co.

Boiler Room Equipment

39 Oil Burners—Bulletin 108 describes concisely Peabody Type A and Type H oil burners, convertible gas oil burners, and burners for two or three fuels. Construction, design and performance features are included with illustrations. Peabody Engineering Corp.

40 Boiler Linings—The Better Method of Setting and Lining Return Tubular Boilers is a 16-p. report in bulletin form with illustrations and engineering drawings as well as improved methods of setting and relining boilers with Ramtite plastic refractories. Ramtite Co.

41 Fly Ash Elimination—A new attractive 24-p. catalog describes the elimination of fly ash by the use of the 9 VF multiclone dust collector. Details of construction, assembly, collection efficiencies, calculations, typical installations and dimension sheets are included. Western Precipitation Corp.

Miscellaneous

42 Clutches—A new 6-p. Indexing and Free-Wheeling Clutch Bulletin No. K-6 covers clutch applications for indexing, free-wheeling, and backstop operations. Complete with diagrams and engineering data, it explains practical, efficient, multi-engine combinations and prime mover hookups for driving a common load, and, tells how clutches automatically function in such installations. Morse Chain Co.

43 Cleaning—Maintenance Digest is the title of a pamphlet which describes the use of Oakite solutions in 28 maintenance jobs involving prime movers, electrical equipment, compressors, air conditioning and miscellaneous plant equipment. Each one is concisely outlined, giving material and method used, time saved and other advantages gained. Oakite Products, Inc.

44 Floor Material—Flash-Stone, a new floor resurfacer which can be installed without any interruption to floor traffic is announced in a 4-p. bulletin. It is a ready mixed plastic material that is rolled or tamped into a hard surface and can be used immediately. The product bonds to oily floors and can be applied directly to old concrete, steel, stone, wood or brick floors, walks or drives. Flash-Stone Co.

45 Concrete—A new, 16-p. booklet entitled Overnight Concrete describes use of Atlas Lumnite Cement in making concrete which has full working strength in less than 24 hr. after placing, how to get fast results on concrete work in cold weather, and how to place and finish concrete floors ready for service the next day. Atlas Lumnite Cement Co.

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. . . APPLIED TO 1942 PRODUCTION PROBLEMS

War time production goals emphasize the need for dependable power plant equipment—equipment that has proved itself in peace-time production. Efficiency and dependability are more important today than they ever were in the past.

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CENTER: *The "F&E" Underfeed Stoker Series 60. For heating or power boilers rated from 100 H.P. to 300 H.P. Burns either anthracite or bituminous coal.*
BOTTOM: *The "F&E" Underfeed Stoker Series 40. For heating boilers rated from 25 H.P. to 100 H.P. Burns either anthracite or bituminous coal. The ideal stoker for apartment buildings, theatres and public buildings.*

Every "F&E" Stoker embodies the famous "F&E" patented Interval Timer Governor that permits full-stroke, full-speed ram action—the essential to perfect underfeed firing. It also provides an infinite number of coal feeding rates. The Sliding Bottom Retort, the High Efficiency Tuyeres and the Fuel Bed Regulator combine to produce a combination of engineering features that no other stoker can offer.

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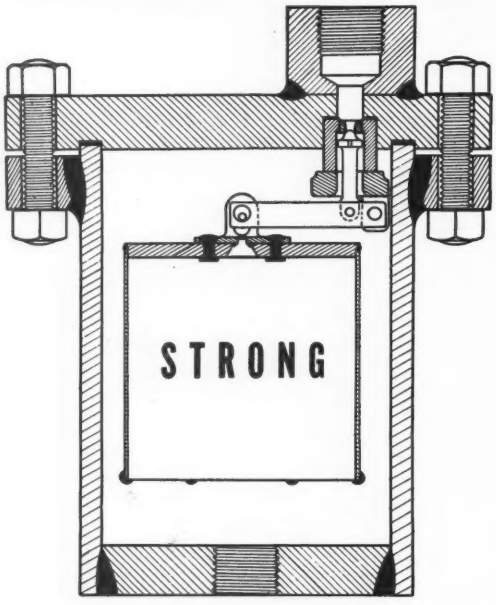

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WAR—Strong Specialties are now needed for war plants (explosives, chemicals, aircraft, ships, etc.) PLEASE CONSERVE present Strong equipment. Use repair parts to restore efficiency . . . increase production . . . save steam (fuel) . . . save money.

14

STRONG
STEAM SPECIALTIES

46 **Sanitation Equipment**—Bulletin 389 describes, illustrates and gives technical information concerning Rex Slo-Mixers which offer the operators of sewage and water treatment plants the advantages of the Langlier Process of Multi-Stage flocculation. Sanitation Equipment Div., Chain Belt Co.

47 **Ventilators**—Bulletin DS-364 describes the new Trane Blackout Ventilators designed especially for blackout plants. Complete with illustrations, the catalog also gives installation and maintenance data and a list of advantages. The Trane Co.

48 **Steam-Jet Ejectors**—Various types of three-stage steam-jet ejectors for general industrial application where high efficiency is required, are described in 8-p. Bulletin W-205-B9. Applications, illustrations are included with operating facts and installations. Worthington Pump & Machinery Corp.

49 **Arc Welder**—Bulletin GEA-3726 illustrates and describes the Strikeasy Arc Welder especially developed for rapid, high quality fabrication of aircraft tubing and all thin-gage metals. General Electric Co.

50 **Diesels**—A 32-p. booklet, Form 7283, pictures and relates the part played in the victory program by Caterpillar tractors. Caterpillar Tractor Co.

Special Request Bulletins

Tubing—A new, convenient Technical Data Card TDC-115 gives a complete table of tolerances for round, seamless-steel, mechanical tubing for both cold-drawn and hot-finished tubes. Request must be made on company letterhead. The Babcock & Wilcox Tube Co.

Engineering Data—The 4th Edition of Revere Weights and Data Handbook has recently been issued because of its interest to technical men and executives in many industries. It is particularly useful right now to many technical men who are in defense work and especially so to those who may not be overly familiar with copper or copper alloys. Those who have a real need for this book can obtain a copy without charge by writing and giving full name, title, and company or government affiliation. Revere Copper and Brass, Inc.

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A WAR MESSAGE
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★ From the United States Treasury Department ★
Winning this War is going to take the mightiest effort America has ever undertaken—men, materials, and money!
An important part of the billions of dollars required to produce the planes, tanks, ships, and guns for Army and Navy must come from the sale of Defense Bonds. Only by regular payday by pay-day investment of the American people can this be done.
Facing these facts, your Government needs, urgently, your cooperation with your employees in immediately assisting them in
A PAY-ROLL SAVINGS PLAN
The voluntary Pay-Roll Savings Plan (approved by organized labor) provides for regular purchase through voluntary allotments. All you do is hold out a definite amount from payroll checks, authorize your employer to set aside that amount and deliver a Defense Bond to the employee each time his allotments accumulate to an amount sufficient to purchase a Bond.
You are under no obligation, other than your own interest in the future of your country, to install the Plan after you and your employees have given it consideration.
WHAT THE PAY-ROLL SAVINGS PLAN DOES
1. It provides conditions under which your employees can most effectively contribute to produce the funds, conditions which are needed to win. 2. It gives every American a way to serve the Government in its financial program. 3. It gives every American wage earner the opportunity for financial participation in National Defense. 4. By steady demand for Defense Bonds it helps to prevent those materials and goods which they are used to produce from being diverted into non-essential channels. 5. It reduces the current demand for consumer goods and thus helps to prevent inflation. 6. It reduces the percentage of Defense costs to be raised by taxation. 7. It helps to maintain a stable market for consumer goods in post-war years by spreading over the war-period the purchasing power for the post-war production of civilian goods so that your employees may be employed. 8. It helps your employees provide for their future.
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GPO 16—20944-1 Form No. DSS-280

Power Plant Construction News

Calif., Needles—Bureau of Reclamation, Denver, Colo., plans call for bids in near future for construction of new Davis power dam on Colorado River, and 28 mi. from Needles. Dam work is estimated to cost about $21,000,000, with complete project to represent a total investment of about $41,000,000, with hydroelectric generating station and equipment, and other facilities. Work will be carried out over a period of months.

Calif., Salinas—Board of Monterey County Supervisors, Salinas, plans new boiler plant for central-heating service at local Monterey County Hospital. Work will be carried out in conjunction with new mechanical laundry, entire project to cost about $160,000. Robert Stanton and Thomas Mulvin, Hotel Del Monte, Del Monte, Calif., are architects.

Conn., Hartford—Cushman Chuck Co., 806 Windsor Street, manufacturer of lathe chucks, etc., plans new boiler house in connection with one-story plant addition, about 53,000 sq. ft. of floor space, for production for Government. Boiler installation will consist of an oil-fired unit, pumping machinery and accessories; a radial brick stack will be built. Entire project will cost over $200,000. Mylchreest & Reynolds, 138 Palm Street, Hartford, are architects; Paul Bemis, 36 Pearl Street, Hartford, is electrical engineer. Work will be placed under way at once.

Ga., Smyrna—Bell Aircraft Corporation, 2050 Elmwood Avenue, Buffalo, N. Y., manufacturer of airplanes and parts, plans installation of electric power equipment in new plant at Smyrna, vicinity of Atlanta, for production for Government. It will comprise several large one and multi-story production units; a power station is planned. Entire project will cost over $25,000,000, with financing to be provided by Defense Plant Corporation, Washington, D. C., a Federal agency. Work will begin at early date. Robert & Co., Bona Allen Building, Atlanta, are architects and engineers.

Ill., Dixon — Stewart-Warner Corporation, 1826 Diversey Parkway, Chicago, Ill., manufacturer of automotive and radio apparatus, plans installation of electric power equipment in new plant in vicinity of Dixon, for production of ordnance for Government, to be constructed by Defense Plant Corporation, Washington, D. C., and operated by company noted. It will comprise a large group of one-story buildings and will be known as Green River Ordnance Works. A boiler house will be built. Entire project will cost about $20,000,000. Hazelet & Edral, 53 West Jackson Boulevard, Chicago, are architects and engineers.

Ill., Sterling — Lawrence Brothers, Inc., manufacturer of builders' hardware, has approved plans for new boiler house at plant, reported to cost close to $30,000, with boiler units and auxiliary equipment. Work will be carried out at once.

Kan., Coffeyville—Municipal Water and Light Department has plans in progress for improvements in municipal power plant, including installation of new boiler units and auxiliary equipment. No estimate of cost announced. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

Mich., Ludington—Dow Magnesium Corporation, Midland, Mich., a subsidiary of Dow Chemical Co., same place, plans installation of electric power equipment in new plant for production of magnesium for Government near Ludington, using brine from wells in that area under an extraction process. Plant will be constructed by Defense Plant Corporation, Washington, D. C., a Federal agency, and operated by Dow company. A power house is planned. Entire project will cost over $30,000,000, with financing in that

Coming In The May Issue—

"Maintaining Power Service In Wartime"

THE May issue of POWER PLANT ENGINEERING will be attuned to the present and future wartime situations of the power plant men. In a specialized 24-page section entitled "Maintaining Power Service in Wartime" the editors will offer practical suggestions on how the power engineer can get more out of his present equipment, and provide for future emergencies. Passed along to POWER PLANT ENGINEERING'S more than 18,000 influential readers will be experiences from foremost power plants and engineering authorities.

Among the significant topics to be discussed in May POWER PLANT ENGINEERING are: More Power For War Production From Venice No. 2 Plant—Emergency Power Installations, Mobile Plants, Floating and on Rails and Trucks—Experiences in Maintaining Water, Electricity and Other Power Services in Europe—Storage Battery Emergency Lighting Plants—How Used Power Equipment Is Helping Overcome Priority Problems.

Advertisers will see in the May "Maintaining Power Service in Wartime" issue of POWER PLANT ENGINEERING an outstanding opportunity to tell how their products or services are geared into wartime needs. The May issue will be sent to many key industrial executives, heads of government departments and power consultants. First forms close April 17. Early space reservations are suggested.

amount to be provided by Government through agency noted. Work will begin soon.

Minn., Red Wing—Northern States Power Co., Eau Claire, Wis., plans new steam-electric generating station at Red Wing, with installation of turbine generator units, high-pressure boilers and auxiliary equipment. Site has been selected on Little River, East Red Wing district. Initial unit is estimated to cost about $1,500,000, with entire station to represent investment of over $4,000,000, with transmission lines, power substations and other facilities.

Mo., Lebanon—City Council plans installation of two deep-well pumping units and auxiliary equipment in connection with extensions and improvements in municipal water system. Entire project will cost about $290,000. Proposed to arrange bond issue in that amount for work. Russell & Axon, 4903 Delmar Boulevard, St. Louis, Mo., are consulting engineers.

N. Y., Brooklyn—Department of Public Works, Municipal Building, New York, plans modernization and improvements in power plant at Kings County Hospital, 451 Clarkson Avenue, Brooklyn, including piping and other facilities. Cost estimated close to $125,000.

N. Y., Johnson City—New York State Gas & Electric Corporation, Ithaca, N. Y., will soon begin work on steel frame superstructure for addition to Westover steam-electric generating station at Johnson City. Additional equipment will be installed for increased capacity. No estimate of cost announced. Atlantic Utility Service Corporation, 61 Broadway, New York, N. Y., is engineer.

Ohio, Bluffton—Board of Public Affairs has plans under advisement for expansion in municipal power plant, including installation of a new 1250-kw. turbine-generator unit and auxiliary equipment.

Ohio, Lima—Ohio Steel Foundry Co., Lima, plans installation of electric power equipment in new plant in vicinity of city for production of ordnance for Government. It will be one-story, about 125 by 800 ft. A boiler house will be built. Entire project will cost close to $800,000, with financing to be provided by Defense Plant Corporation, Washington, D. C., a Federal agency, which will hold title to property. Albert Kahn Associated Architects & Engineers, Inc., New Center Building, Detroit, Mich., is architect and engineer.

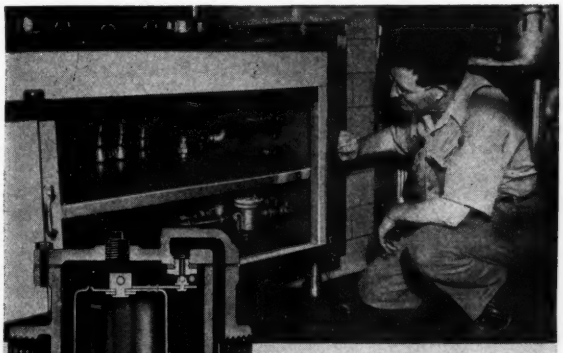
Ohio, Toledo—Lycoming Division, Aviation Mfg. Corporation, Williamsport, Pa., manufacturer of airplane engines and parts, plans installation of electric power equipment in new plant in vicinity of Toledo, for production for Government. Plant will comprise several large units. A power station will be built. Cost estimated close to $7,000,000. Financing will be provided by Defense Plant Corporation, Washington, D. C., a Federal agency, which will retain title to property.

Ore., Portland—Henry J. Kaiser Co., Inc., Latham Square Building, Oakland, Calif., operating shipyards and other industrial properties, plans power house in connection with new shipbuilding plant at Swan Island Airport, Portland, recently leased from Portland Port Commission. Plant will have series of 10 shipways and large group of shops, and will be operated for construction of vessels for Government. Electric power equipment will be installed. Entire project will cost close to $15,000,000, with financing to be provided by United States Maritime Commission, Washington, D. C.

Pa., Philadelphia—Bureau of Water, Department of Public Works, City Hall Annex, is asking bids until April 8 for electric switchgear, power transformer and control switchboard for Torresdale pumping station of municipal water system. Electric equipment noted to be used for nine pumping units with rated capacity of 212,000,000 gals. per day. Plans at office of Bureau of Water, Room 241, Chestnut Street Pier.

W. Va., Benwood—Wheeling Steel Corporation, Wheeling Steel Building, Wheeling, W. Va., plans expansion in power plant facilities at mills at Benwood and Steubenville, Ohio, in connection with extensions and improvements in both plants for increased production for Government. Cost close to $18,000,000, with financing to be provided by Defense Plant Corporation, Washington, D. C.

Wis., Waupun—National Rivet & Mfg. Co., manufacturer of riveting machines, parts, etc., plans installation of electric power equipment in new two-story plant addition, about 180 by 185 ft. Entire project will cost over $100,000. Proposed to carry out work in spring. Roger A. Sutherland, 259 East Wells Street, Milwaukee, Wis., is architect.



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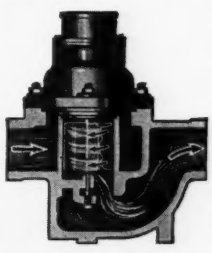

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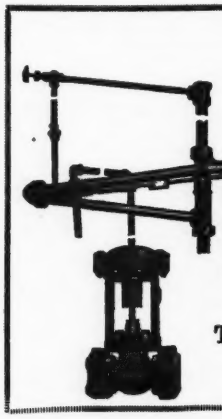

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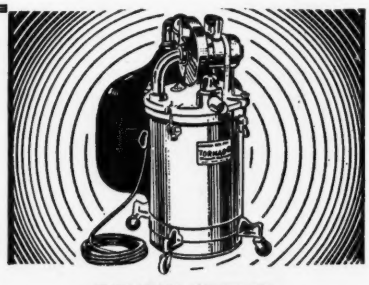

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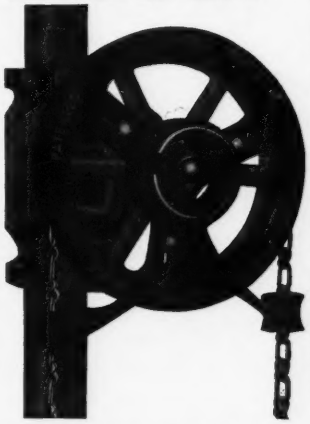

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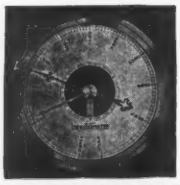

Approved for gauging hazardous liquids by Underwriters' Laboratories and other similar groups.

Models available to automatically control pumps, motors, signals or other devices for maintaining minimum or maximum liquid levels.

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There's a Manzel Lubricator for Every Lubrication Job

Whether it's lubricating a steam or Diesel engine, a compressor, pump or other heavy machinery; whether you need one or twenty feeds, there's a Manzel Automatic Force Feed Lubricator to exactly meet your requirements.

Manzel Lubricators are simple, sturdy lubricating pumps which deliver accurately measured amounts of oil to engine cylinders and bearings with unfailing regularity. They start, stop, speed up and slow down with the engine. The only attention they require is to keep the reservoir supplied with oil.

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BOILER TUBE CLEANER
STURDY — DURABLE — RELIABLE — THOROUGH

The right tool for a real tube cleaning.

For lower fuel bills and more power, use a Vibratap—the vibratory cleaner that operates efficiently on a steam or air pressure of about 45 pounds and removes all scale from fire tube or water tube boilers. Model shown is for fire tubes.

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Republic Flow Meters Co.

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Hays Corporation, The
Republic Flow Meters Co.

METERS, COAL
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Engineer Co., The

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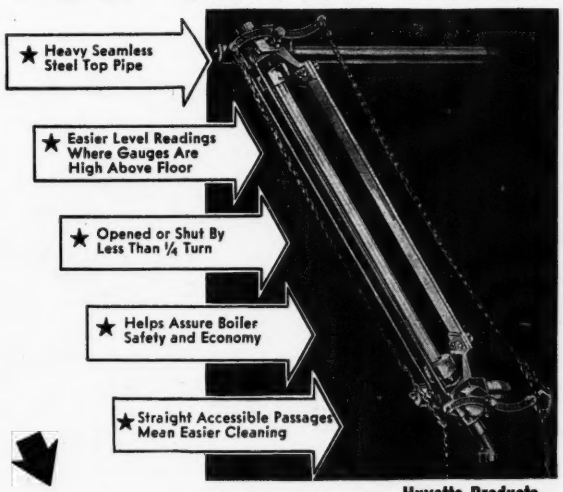
Get these Advantages with
"P B H" *TILTVIEW GAUGES*


★ Heavy Seamless Steel Top Pipe
★ Easier Level Readings Where Gauges Are High Above Floor
★ Opened or Shut By Less Than ¼ Turn
★ Helps Assure Boiler Safety and Economy
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Now with increased boiler safety and economy a wartime rule, "PBH" Tiltview Water Gauges for high-up locations are a timely investment. Tiltviews offset right or left. Write today for latest catalog and prices.

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MAKE OLD MOTORS YOUNG
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New **IDEAL COMMUTATOR CLEANING STONE**
Quickly removes excess film and deposits of brush material.

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Prevent Costly Shutdowns
Keep Motors On The Job. No dismantling necessary when you use IDEAL Resurfacers in order to maintain peak efficiency of commutators or slip rings—or to restore scored, ridged or burned surfaces. Grades, sizes, shapes to meet all conditions and requirements.

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Infilco Incorporated
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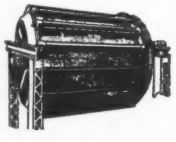
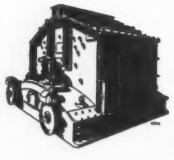


BRADFORD BREAKERS
Reduce R.O.M. for Stoker or Pulverizer feed with absolutely no oversize and low "over-grinding." Crush by *gravity-impact*. Automatically eject, without damage, tramp iron, mine debris and hard rock. Low H. P. . . . slow speed . . . long life. Low upkeep . . . rugged . . . thoroughly dependable. 25 to 500 T.P.H. Steelbuilt. Patented.
Bulletins No. 3005 and No. 3004.



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The Central Feed **REVERSIBLE** is the most outstanding advance in Hammermill design in 20 years . . . **REVERSIBILITY** is an exclusive "Pennsylvania" feature. Automatic hammer turning. Feed R.O.M. or smaller . . . Adjustable Cages . . . Tramp Iron protection. Rugged . . . dependable. 25 to 500 T.P.H. Steelbuilt. Patented. Bulletin No. 1030.

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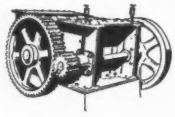

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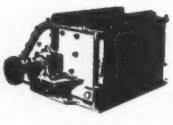

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LIBERTY TRUST BLDG.
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375 KVA G. E. condensing turbine unit
4 Stage Form B 200 lb. steam
240 Volts 3 phase 60 cycle 3600 RPM
Equipped with S & K multi-jet condenser
Without exciter
With two Goulds condenser pumps and common base, but without motor.

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1—Nordberg Unaflow Engine directly connected to 175 KW. alternating current generator with complete equipment except switchboard.
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Williams Valve Co., The D. T.
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Combustion Engrg. Co., Inc.
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Flynn & Emrich Co.
Iron Fireman Mfg. Co.
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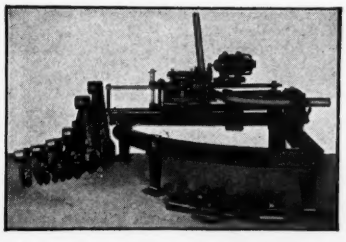


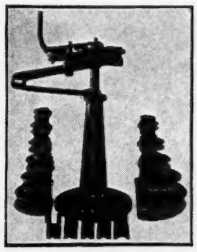
FOR NATIONAL DEFENSE

We Are Ready To Serve You

The American Cold Pipe, Conduit and Tube Bending Machines

QUICK DELIVERIES . . .

HAND OPERATED TYPES **in capacities of 1 in., 2 in., 3 in., and 4 in.**



MOTOR OPERATED **in three capacities, ½ in. to 4 in., ½ in. to 6 in., and ½ in. to 8 in.**

Early shipments on hand operated machines; on motor powered from four to six weeks.

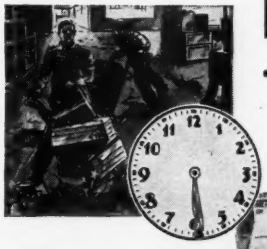
Wire or air mail letter for printed matter and prices.

Three New Machines: No. 1. For bending extra heavy pipe up to 3". No. 2. For bending all kinds of thin gauge tubing without use of mandrel. No. 3. For bending IPS conduit.

AMERICAN PIPE BENDING MACHINE CO., INC.
27 Pearl Street **Boston, Mass., U. S. A.**

NEW! . . . A TOUGH FLOOR PATCH

. . . That's Ready for Traffic in One Minute



REPAIR rough, broken Factory Floors speedily for instant traffic use. Ready mixed INSTANT-USE Resurfacer makes a quick—good solid job. Simply shovel into hole and tamp. Run traffic over patch immediately. NO WAITING! Bonds tight to concrete or wood. Used, too, for complete overlay.

Make This Test!

You can prove to your own satisfaction the unusual merit of INSTANT-USE RESURFACER through our FREE TRIAL OFFER.

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Tell me about INSTANT-USE RESURFACER over concrete or wood, and details of FREE TRIAL OFFER. No obligation.

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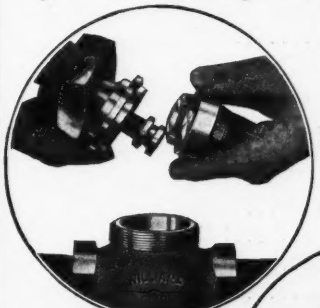
for trouble-free valve jobs



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Cincinnati, Ohio

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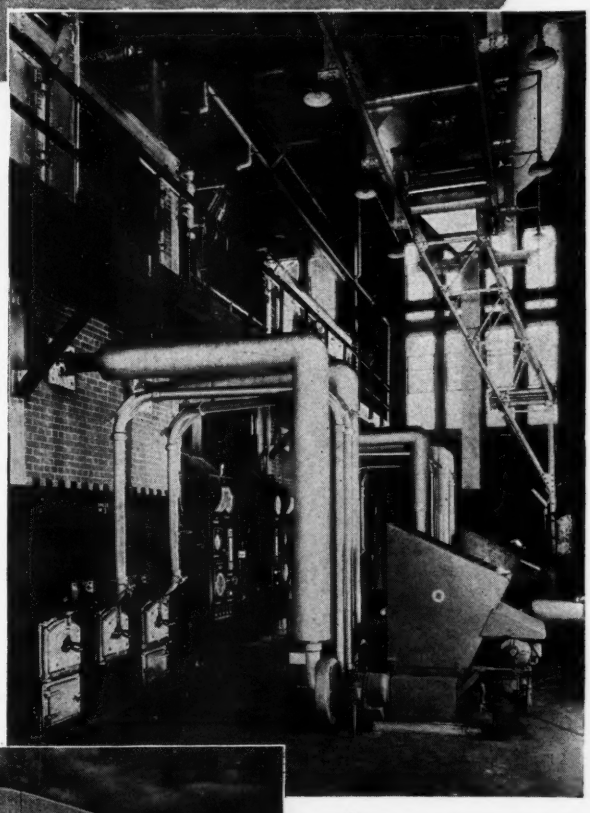
PNEUMATIC SPREADER

DEVELOP 79.6% EFFICIENCY...



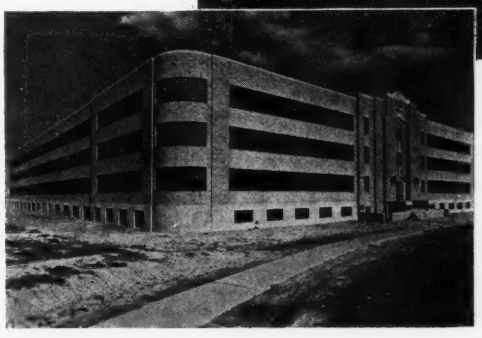
...in the U. S. Department of Agriculture Laboratory

"After the plant was put in operation, official tests were made by the U.S. Bureau of Mines Fuel Economy Service . . . the boiler efficiency proved to be 79.6% . . . approaching the maximum for simple boiler design without extended-heating surface."

THIS is a highlight from a recent article in "Power", written by T. A. Marsh, author of "Combustion in the Power Plant." He describes the operation of three 2000-lb. per hour, Iron Fireman dual-feeder, pneumatic-spreader stokers in the U.S. Department of Agriculture's laboratory at Wyndmoor, Pa.

"Each stoker has two feed worms driven by a 1½ h.p. motor through variable-speed pulleys in combination with a three-speed transmission," the report continues. "The feed worms meter the coal to transfer housings, from which gas streams convey it to the furnace. The fines burn in suspension and the larger pieces form the fuel bed. The nozzles which deliver coal to the furnace have adjustable tips for distribution control, insuring uniform spreading over the grate area.

"Maximum turbulence is the result because the conveying stream enters the furnace at right angles to the flow of forced-draft gas from the fuel bed."



Notice the clear boiler fronts in the Wyndmoor Laboratory. Coal is fed to the Iron Fireman Pneumatic Spreader hoppers by traveling weigh lorries. These boilers are straight tube, vertically baffled, with box header. They are nine high by twelve wide single drum units with 4" diameter tubes. Each of the three contains 2,000 sq. ft. of heating surface. No economizers, water-walls, preheaters, or superheaters are used.

U. S. D. A. Laboratory at Wyndmoor, Pa., where Iron Fireman Pneumatic Spreader stokers have made a remarkable record.

IRON FIREMAN

AUTOMATIC COAL STOKERS

THE IRON FIREMAN

Send for Free Book on Pneumatic Spreader Stokers

Book contains full descriptions, capacities, operating data, etc., with layouts and photos of 10 actual installations. We will send it free, on request. Write to Iron Fireman Manufacturing Company, 3314 West 106th Street, Cleveland, Ohio.

"THAT'S NO MUSEUM PIECE, THAT'S FLAMENOL CABLE.. LEMME TAKE IT HOME TO USE!"

THOUGH he's a collector of prehistoric or ancient objects, the Professor knows a good thing when he sees it! Perhaps from his own experience with electric equipment he realizes that Flamenol* cable has *all three* desirable qualities: resistance to aging, oil, and flame.

To judge for yourself how well Flamenol incorporates these qualities, consider these facts:

1. AGING RESISTANCE. Under accelerated-aging tests, Flamenol stands up better than any known rubber compound; in fact, it shows no signs of deterioration. It does not oxidize and should last for years.

2. OIL RESISTANCE. Flamenol cable is not affected by oils, coolants, water, inks, acids, alkalies, or solvents. It's flexible and easy to install.

3. FLAME-RESISTANCE. Flamenol will not support flame. It is listed by the Underwriters' Laboratories, Inc., for voltages up to 600, at temperature limits from 60 C to 80 C.

In getting a cable for all-round uses—especially for machine-tool and switchboard wiring—ask for Flamenol. Another advantage is that 12 colors are available (black, white, red, green, light-blue, navy-blue, yellow, brown, orange, purple, pink, and gray). These colors are bright and clear, making circuit tracing simple. For good tips on where to use Flamenol, see Bulletin GEA-2733D.

*Reg. U.S. Pat. Off.

FLAMENOL—The many-purpose, long-lasting, synthetic-insulated cable

Flamenol cable contains no rubber. It has high dielectric strength—superior to that of most rubber cables. It is tough, and needs no protective finish except under extremely severe conditions.

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"CHEATS the UNDERTAKER"

longer than any similar Small Valve

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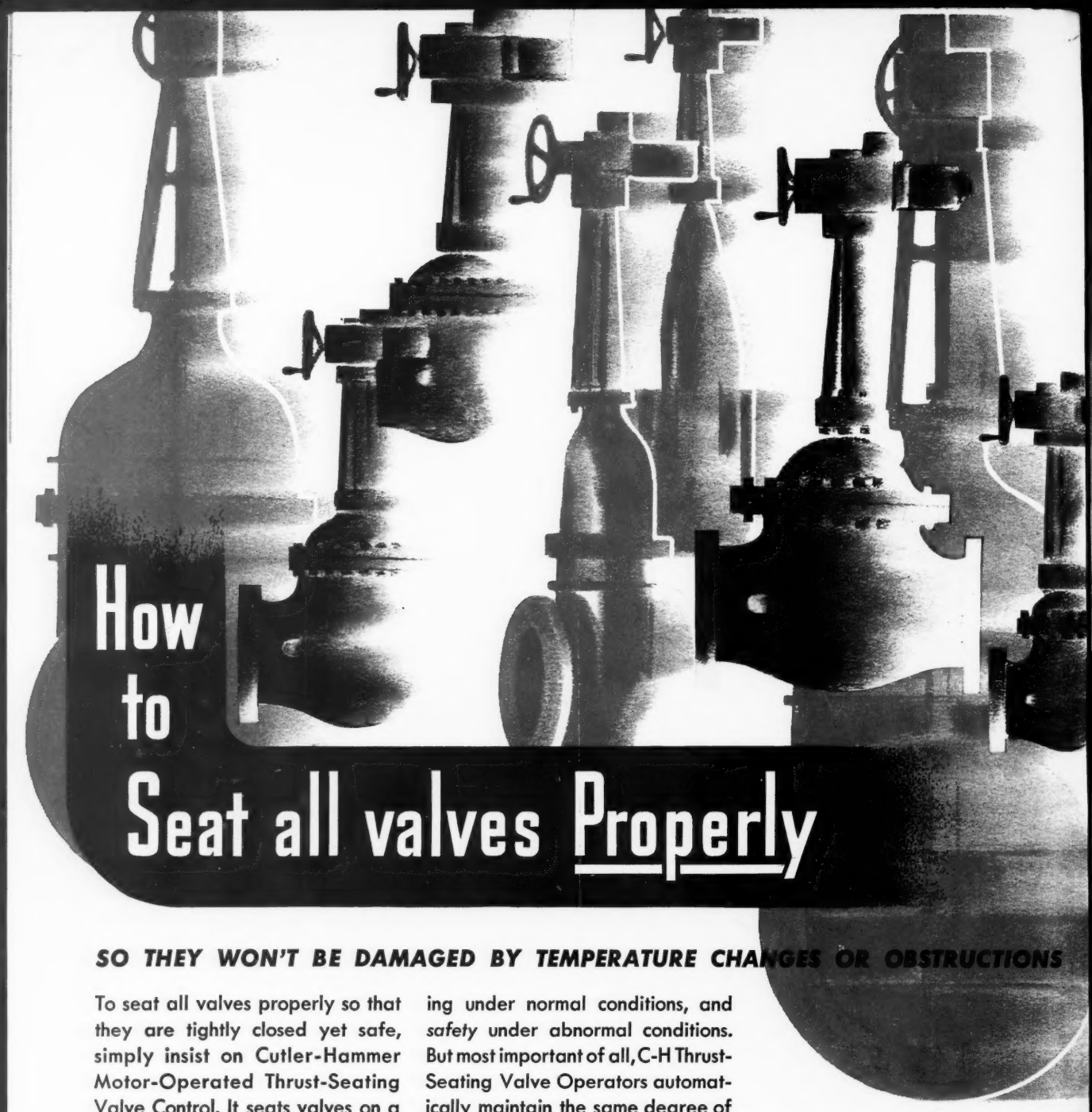
CHAPMAN LIST 960

Forged Steel Gate Valves

CHICAGO, APRIL, 1942



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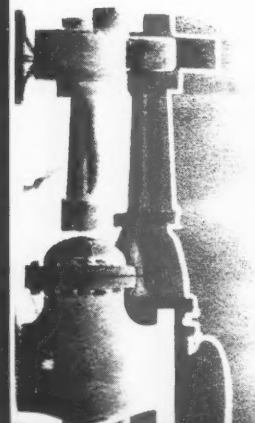
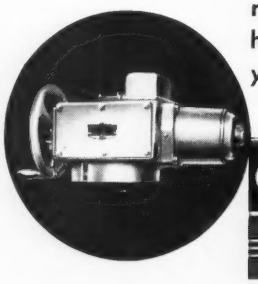
SO THEY WON'T BE DAMAGED BY TEMPERATURE CHANGES OR OBSTRUCTIONS

To seat all valves properly so that they are tightly closed yet safe, simply insist on Cutler-Hammer Motor-Operated Thrust-Seating Valve Control. It seats valves on a proven "controlled-thrust-seating" principle. That means *accurate* seating under normal conditions, and *safety* under abnormal conditions. But most important of all, C-H Thrust-Seating Valve Operators automatically maintain the same degree of tightness as valve parts expand under *high* temperature and contract under *low* temperature. That's why with C-H Valve Operating Units you never get jammed valves, you never have to "back-off" valves . . . *and you won't be faced with shutdown at a time when continued, trouble-free operation is at the highest premium in history.* Insist on Cutler-Hammer Valve Control. For gas, water, high and low pressure steam service—in fact for any valve where fast, reliable operation and accurate seating can save you time, trouble and expense. It offers you every feature—plus. CUTLER-HAMMER, Inc., 1210 St. Paul Ave., Milwaukee, Wis. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.





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